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Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICE—
Eleventh Annual Meeting, Ohio Gas Light Association 361
EDITORIALS—
Briefly Told 361
The State of Trade—This Week, at Springfield, Ohio—Notes.
*A Twenty Cubic Foot Meter Prover, by Mr. H. C. Slaney 362
The Efficiency of Carbon Vapor in Coal Gas and other Hydrocarbon Flames, by Mr. L. T. Wright 363
Producer Gas as Applied to Foundry Purposes, by Mr. Geo. T. Prince 364
Regenerative Gas Stoves 366
Electric Wiring and the Fire Risk, by Mr. F. E. Cabot 367
How to Extinguish an Oil Fire in a Cellar 369
On the Estimation of Sulphur in Pyrites, by Prof. G. Lunge 369
Mr. Chas. F. Brush on the Infancy of Electric Lighting 371
Incandescent Lighting by Gas 371
ITEMS OF INTEREST FROM VARIOUS LOCALITIES 372
Dividend Declared—Annual Meeting, Carbondale, Pa.—Annual Meeting, Providence, R. I.—Annual Meeting, Charleston, S. C.—Proposing to Change the Meter Inspection Laws, New York—Petitioning for Cheaper Gas Rates, Brockton, Mass.—Suit for Damages, Gardner, Mass.—Contracts for Mr. Adam Weber—The Bartlett Lamp Company in New Quarters—Something from Norwich, Conn.—Sale of New Stock, Brookline, Mass.—A Pennsylvania Bill—An Even Gas Rate for Brookline—No Increase in Salary List, Massachusetts Commission—Contract for the Berlin Iron Bridge Company—The Situation at Montreal—An Illinois Bill—Something from Omaha, Neb.—Cheaper Gas for New London, Conn.—Advances at Middletown, N.Y.—And Many Other Items.
A Firedamp Indicator 373
The Market for Gas Securities 374
Tests of Non-Conducting Pipe Coverings 374
Injuries to Workingmen from Defective Machinery 374

[OFFICIAL NOTICE.]

Eleventh Annual Meeting, Ohio Gas Light Association.

OFFICE OF THE SECRETARY, COLUMBUS, O., March 4, 1895.

To the Members of the Ohio Gas Light Association: The eleventh annual meeting of the Ohio Gas Light Association will be held in the parlors of the Arcade Hotel, Springfield, O., March 20th and 21st, 1895, for which occasion the following papers will be prepared:

"Changing the Arrangement of a Retort House, and the Practical Benefits Derived Therefrom," by Mr. A. F. Nash, Windsor, Ontario.

"Prepayment Gas Meters," by Mr. Jno. D. McIlhenny, Philadelphia, Pa.

"Cannel Coal as an Enricher," by Mr. Graham Macfarlane, Louisville, Ky.

"Incandescent Burners," by Mr. H. Wilkiemeyer, Evansville, Ind.

"What Proportion Should Holder Capacity Bear to Maximum Output?" by Mr. E. T. McCormack, London, Ohio.

"The Growth of a Gas Plant," by Mr. E. C. Gwyn, Springfield, Ohio.

"Carbide of Calcium," by Mr. Henry L. Doherty, Columbus, Ohio.

"Hints on Handling Gas Stoves," by Mr. Charles V. Newman, Peoria, Ills.

"Soft Coal Water Gas," by Mr. W. S. Bowen, Louisville, Ky.

Members are requested to come prepared to take active part in discussions of the foregoing, and of the "Question Box" also, to which they are asked to contribute. The meeting will open at 10 A.M. Wednesday, March 20th. Headquarters will be at the Arcade, but first-class accommodations can also be secured at the Lagonda House, at both of which places special rates will be made for members of the Association.

Application blanks for membership can be secured of the Secretary, who will be pleased to give any information desired.

A. P. LATHROP, Secretary.

BRIEFLY TOLD.

THE STATE OF TRADE.—Our returns from the points selected throughout the country for the purpose of arriving at an accurate determination respecting the standing of the gas business in the last half of 1894, as against the last half of 1893, are eminently satisfactory, in that they show a return to normal conditions in the trade. The returns are from 58 points, and, as is our usual custom, these were selected with a view to obtaining the indications of an average of large, medium and small sized works. The 58 places return a total output for the last six months of 1894 of 1,700 millions cubic feet, and the same places in the last half of 1893 reported a total output of 1,654 millions cubic feet, which goes to show that, even if the percentage increase is small, the gain is satisfactory. Some of those reporting, whose figures were not received until the past week, make the assuring report in addition that their outputs for January and February, 1895, are well in excess of the outputs for the corresponding months of 1894. Seven Companies supplied us with

information of this sort, and the maximum percentage gain amounted to 18 per cent., with a minimum of 7, and an average of 10.4. A feature of the returns is the credit given to the Welsbach incandescent burner for displacing incandescent electric lights, one Company asserting that it replaced no less than 1,620 electric burners, a result that was attained in a city the population of which is something less than 19,000. In 6 of the 58 places making returns reductions in the selling rate were made, the average reduction figuring out 15 cents per 1,000 cubic feet, and one Company reports what is virtually an increase, through the cutting off of special prices to certain large users, the revision amounting to about 8 cents per 1,000 cubic feet on all the gas sold by it. Take it all in all, the results cannot fail to be satisfactory to every one interested in the manufacture and sale of gas.

THIS WEEK, AT SPRINGFIELD, OHIO.—The preliminaries in connection with the Ohio Association's eleventh annual meeting, which will be in progress at Springfield before this issue of the JOURNAL is in the hands of all of its readers, have been completed, and if one may judge of what is to come out of the signs that precede the happening, there is no room for an opinion other than that the sessions are to be instructive and enjoyable. The change of the meeting place from Columbus to Springfield will have the spice of variety about it, and will further give the Association's Chairman (Mr. J. W. R. Cline) a chance to show that General Bushnell and he are up to date in every respect—although of that standing of theirs very little is or ever has been left to chance. The President's inaugural message is to be well supplemented by a fruitful looking list of papers, which moves one to the remark that the Ohio gas men, as usual, have found no difficulty in selecting topics of interest for comment and discussion, nor in finding time to prepare the subject matter of their chosen themes. Possibly we went a trifle too far in designating the writers of the papers as Ohio men pure and simple, since a critical look at the names of the nine posted authors shows that only three are Buckeye men pure and simple; but this only proves that the Ohioans are great persuaders. The list is varied and strong, even if some of the numbers, judged by their titles, look to have a leaning towards the commercial side; but of that who may say in advance, when one remembers how deftly and uncommercially Mr. Eaton, of Jackson, Mich., addressed himself to answering the query which headed his paper on "Whose Make of Lighting Fixtures Shall We Recommend?" read at the meeting last month of the Michigan Association. We note, too, that a man from "over the border," Mr. Nash, of Windsor, Ont., is to contribute to the fund of information that is to be at the Association's disposal, which goes to show that even the limits of the States are powerless to restrict the appeals of the Ohio Association's clever Secretary. It is presumed that those who will be in Springfield this week have already secured their quarters for the sake of insuring their comfort, although we imagine that the proprietor of the Arcade, and the Lagonda as well, can be counted on to take good care of all comers, even at short notice.

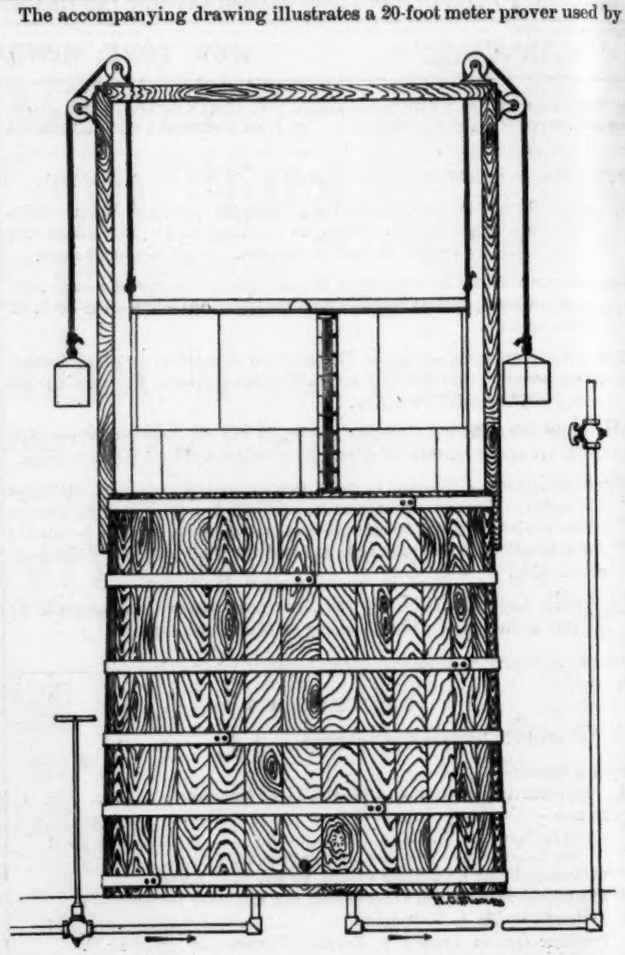
NOTES.—The bill fathered by Senator Persons in the New York Legislature, which purports to have for its aim the abolition of the post of official gas meter inspector for the State, is nothing more nor less than a Republican grab for offices now filled by Democrats, since it proposes to create, instead of the present inspection monstrosity, a still more ridiculous system. Not only does it retain an equal number of inspector and inspector's deputies, but declares that there shall be an additional deputy, at $2,000 per annum, and a Secretary at $1,200, and that the chief inspector shall have his headquarters in Albany instead of New York. Perhaps the scheme of increase is defended by Senator Persons on the score that hereafter the inspectors shall also have supervision over electric meters, in which argument there might be a grain of common sense; for if the inspectors are to watch closely the vagaries of the electric meter, they will have much to do. The whole scheme, though—the present as well as the one that is underway—is absurd, for the work which it is proposed to accomplish ought to be performed in a thoroughly complete manner at a cost to the State not in excess of the single salary that is to be given to the "chief inspector."——The Delta Electric Company, of Cairo, Ills., after an existence of three years, during which time, however, its promoters managed to bamboozle Cairo and other capitalists out of $65,000, is in the hands of a receiver, appointed on the petition of those with whom the decreeing judge (Mr. Harker) agreed that the "Company was wholly insolvent." Meantime Mr. Rathell, of the Cairo Gas Company, keeps on earning the funds necessary to pay the bills incurred.——The Delaware County Gas Company, of Chester, Pa., will bid on the public street lighting, the lamps to be used to be of the Welsbach outdoor type.

A Twenty Cubic Foot Meter Prover.

[Prepared for the JOURNAL, by MR. H. C. SLANEY.]

It is the pride of a great many engineers to have under their supervision a well appointed works containing all the most improved apparatus. This is a wise provision on the part of a systematically conducted gas company, for from an economical point of view the men take better care of good machinery than of those ramshackle affairs we often meet with in works under slipshod management. The meter prover of the "Gas Light Company, of Baltimore," was not an exception to this rule. This apparatus, like many of our day, was placed in an obscure room, on low, damp ground. Why this is so is hard to understand, for one cannot conceive why a meter repairer or prover should be compelled to pass his existence in some subterraneous and dismally confined quarters to make repairs, finish and prove his work—which requires care and judgment—when there are other places about the establishment more suitable both for the men and the work in hand.

The accompanying drawing illustrates a 20-foot meter prover used by



the "Gas Light Company, of Baltimore," in 1832. The original was constructed by Mr. Samuel Crosley, of England, and on its becoming worn out by rust was replaced by a new one made by Mr. John M. Slaney, Sr., who made an improvement by the addition of a scale as shown. The tank was about 37 inches in diameter by 42 inches in height, composed of about 1¼ inch thick cedar staves, held together with six wrought iron hoops. Near the bottom was a wooden plug to allow the water to be drawn off when necessary. Secured to the sides and extending above the tank was a suspension frame of oak, of about 1½ inches thick by 3 inches wide. Upon each side and top of frame were fastened two small grooved guide wheels, about 2½ inches diameter. The holder was about 35 inches diameter by 39 inches high, the shell of which was composed of four rings of small plates of heavy tin, there being but a few sizes from which to choose. The crown or top was flat. To keep the top in shape and from sagging it was strengthened by the addition of two semicircular pieces, each about 2 inches diameter, and placed at right angles with each other, then covered with tin and securely fastened to crown with solder. The holder was without either

guide rollers or wheels for its guidance in the tank, depending entirely upon its suspension cords. The ends of these cords were attached to two ear lugs that were fastened to the sides of holder; the other end passed up and over two guide wheels, tied to two cast iron counterweights, to counterpoise. The inlet and outlet pipes were of copper, ¾ inch diameter outside. A meter cock was placed in the inlet pipe between the service pipe and prover. The flow of gas was regulated by a T-handle wrench extending through the floor, the length of which was sufficient to enable the operator to handle with when filling the prover with gas. On the outlet pipes was inserted a T-handle cock for regulating the flow of gas to the meter on prover bench. The elbows and cocks were of cast brass; these, together with the copper pipe, were all made in the Gas Company's shops. Rubber hose was not then in use, and from the want of its flexibility they were obliged to resort to Π-pieces of pipes for the purpose of connecting up the meters. Oftimes the meters were not of the same height, from the few different makers, which necessitated the unsoldering of the Π-pieces and the lengthening or shortening of these pieces, as the case might be. It was then resoldered, all of which consumed the meter prover's time. What a tedious operation this must have been from our standpoint of observation in this electrical age! The meter prover which was placed upon the market some years later by these men was very much improved in convenience for work and symmetrical in appearance, the lines of which were pleasing to the eye both for their proportions and ornamentation. They added from time to time such luxuries as the requirements of progressive science demanded, thermometers and barometers for water and air, the involute counterpoise, dry valves for air tests, rubber hose, and then the graduated openings for different size meters.

The Efficiency of Carbon Vapor in Coal Gas and Other Hydrocarbon Flames.

[Abstract of a paper read before the London Section of the Society of Chemical Industry, by Mr. Lewis T. Wright.]

Many of the scientific chemists who have studied the details of gas manufacture have endeavored to trace a relation between the illuminating power and chemical composition of coal and similar illuminating gases. These efforts, though they have not been attended with success, have led to the advancement of our knowledge of the composition of coal gas, and have also brought about some improvement in methods of gasometric analysis. Among the various reasons that must have led to failure, even if such relation existed, must be cited: (1) The want of a definite system of photometry as applied to gases of various qualities. (2) The practice of arbitrarily dividing the hydrocarbons of coal gas into marsh gas and $C_n H_m$ hydrocarbons absorbable by fuming sulphuric acid. There is much uncertainty about the *rôle* played by marsh gas in mixtures; and there is the error also commonly held that coal gas can be disillumined by treatment with fuming sulphuric acid.

The author repeats his observation that marsh gas is but a convenient mode of expressing the carbon of the paraffins present in coal gas. It is known that, if the $C_n H_m$ hydrocarbons be removed, the residual luminosity is 40 per cent. of the original; and the author asks if, supposing the reverse operation could be performed and only the so-called marsh gas be taken out, whether the residual gas would then possess 60 per cent. of the original luminosity. He states that, in mixtures such as coal gas, methane has a very important luminosity. His idea, which was illustrated by the analysis of four samples of gas ranging from 15.6 to 20.5 candles, that there was a relation between the total carbon of the gas and its illuminating power was repeated, but not extended, by Professor W. Foster.

The use of the word intrinsic luminosity to hydrocarbons is unfortunate, as we know nothing of the intrinsic luminosity of such bodies which can be made to produce luminosity from zero up to limits not yet reached according to the manner of consuming them. There is, however, a conventional luminosity that is the maximum that can be obtained with the ordinary flat-flame and Argand burners. The want of a burner especially adapted to very low qualities may have originated the idea that methane and coal gas deprived of the $C_n H_m$ hydrocarbons possessed no practical luminosity. The operation of photometry is not capable of the accuracy obtainable with other scientific methods, such as weighing, etc.; nor has it been reduced to a system so far as gases of different qualities are concerned. Luminosity is not a fixed property, unless all the conditions are fixed. Change these conditions, and the luminosity changes.

The author, in the course of his experience with gases of widely different quality and origin, has found that, if only the carbon combined with hydrogen be considered, there is a relation between the luminosity and composition. To state the rule in a simple, practical form for application to gases, it is necessary to consider that the carbon is of density 1—that is to say, treat the carbon as though the average hydrocarbon molecule contained but one atom. Thus, for the purposes of applying the constant, all the carbon combined with the hydrogen must be calculated to density 1. The same result is obtained if the equivalent volume of carbonic acid be taken; or the quantity of carbonic acid that would be yielded by the gas on combustion with oxygen after deducting the carbonic oxide and, of course, any carbonic acid originally present.

The author's experiments have been made upon carbonic acid and air-free gases. He finds that every cubic foot of carbon vapor so expressed has a lighting value of about 7 candles, according to the class of gas. Thus, ordinary 16-candle gas may contain 50 volumes of carbon vapor per 100 volumes, or 0.5 cubic foot per cubic foot of coal gas. Taking the constant of 6.65 candles for such gases, 0.5 cubic foot would give $0.5 \times 6.65 = 3.325$ candles per cubic foot, or 16.675 candles per 5 cubic feet. For oil gases he has obtained values of about 6.9 candles per cubic foot of carbon vapor. He refers to various authorities, and shows that their analyses, calculated according to his method, give similar values. For petroleum burning in a "Duplex" lamp he has obtained values of from 6.7 to 7.33 candles per cubic foot of carbon vapor; and he explains how it is that the values obtained for hydrocarbons in the pure state are not necessarily reproduced in mixtures.

Referring to the use of oil for enrichment purposes, he shows that if 25 per cent. of the oil on destructive distillation be kept as residue, then the remaining carbon, on taking the constant 7, or its equivalent of 221 candles per pound weight of effective carbon, should give 1,127 candles per gallon. In his own experiments he has reached 1,084 candles. The author, alluding to the value of these oil gases for enrichment, thinks it necessary to have analyses of the enriched gases, in order to decide the point whether the enriched gas has a higher carbon efficiency than the gases separately. Petroleum in lamps gave from 1,580 to 1,680 candles per gallon. In that case all the carbon is consumed, and the carbon efficiency varies from 6.7 to 7.3.

In carbureted water gas processes, values of from 1,300 to 1,500 candles are obtained; and it is necessary to have analyses before deciding whether this higher value be due to increased carbon vapor put into the gas by cracking the oil in water gas instead of its own vapor, or if it be from an increased efficiency of the carbon vapor.

The author points out that the ratio of carbon to hydrogen in these gases can differ immensely without any great change in the efficiency of the carbon vapor. He also refers to the very discrepant results given for benzol as an enricher, and points out that some of the results do not justify the conclusions drawn from them. He further asserts that some of the so-called enrichment curves are really only curves on account of the inequality of the system applied in testing photometrically the various mixtures.

It is also stated in the paper that the marsh gas prepared from sodium acetate, which, though consisting mainly of marsh gas, is not pure, being accompanied with many other bodies, gave, under conditions that were perhaps not favorable to the full development of its maximum, a luminosity of 5.73 candles per cubic foot of carbon vapor.

Several other matters are referred to in the paper, such as the probable effect of cheap enrichment and the distillation of coal. On several occasions the author has shown that an increase of destructive distillation of coal brings out more lighting value from the coal, though the gas obtained is of a lower grade. This increase is, of course, attended with the permanent gasification of more carbon, and appears to be principally at the expense of the tar. On taking charge of the Nottingham Corporation Gas Works in 1883, he found that there was a coal mined on the outskirts of the town, which for years had been regarded as useless, though the coal owners were willing to deliver it at $1.50 per ton. The coal had been tested, and was found to yield very little gas, and was consequently despised. The author examined the coal and found that, at a temperature perfectly practicable in gas works, it would yield remarkably good results. In the paper he gives a large number of results obtained from this coal, at various temperatures. They ranged from—

Cubic Feet per Ton.	Candle Power.	Value in Candles per Ton.
6,595	23.56	31,076
11,001	20.08	44,180

The result of using this coal was immediately to produce a saving that amounted, before the end of the year, to $50,000, which sum was quick-

ly absorbed in the borough rate of the town. Now that the price of petroleum and paraffine oils is so moderate, and the cost of enrichment is not a serious matter, the author thinks that high yields will come more into vogue. Of the selling price of gas in the metropolis, 80 per cent., he says, is made up of charges that are quite independent of the quality of the gas supplied, and that figure would be the same if the gas were either of 14 or 18-candle power. Of this large proportion of 80 per cent., it is generally found that the cheapest light is that supplied at the highest grade; and, for example, the author instances London, Liverpool and Glasgow—

	Candle Power.	Cost per Candle of the Standard.
London	16.3	4.16 cents.
Glasgow	21.3	3.08 "
Liverpool	21.6	3.32 "

After his experience in the manufacture of gas in London, Nottingham (where it was 18½ to 18¾ candles), and Buenos Ayres (with gas at 25 candles), the author is at a loss to understand the arguments in favor of the reduction of the standard of illuminating power in London. He regards this as a retrograde step, and likely to lead to a serious loss of prestige. He considers that it is against economical principles, since, to-day at least, gas light can be supplied cheaper at a high than at a low grade. He acknowledges the lower price appeals to the agitator; but quality, he says, appeals more to the consumer.

In conclusion, Mr. Wright says he hopes, now that attention has been directed to the efficiency of carbon in coal gas and other hydrocarbon flames, that the analysis of gas may be employed in combination with the photometer, and then, he thinks, we shall learn much more about the efficiency of carbon than he was able to tell his auditors that night.

Producer Gas as Applied to Foundry Purposes.

[A paper read by Mr. George T. Prince, of Philadelphia, at the February meeting of the Foundrymen's Association.]

In presenting to your attention the subject of producer gas, and some of the advantages which may result in its application to the treatment of iron and steel, I desire to avoid technicalities and confine myself as far as possible to a plain statement of the subject, presented in a manner that will be easily understood by one who has not given the matter special thought. Competition and the consequent low prices which prevail in almost all lines of industry are continually forcing manufacturers to curtail in every possible way the cost of making their product. Goods which require in their manufacture the application of heat have experienced the tendency of the time in a marked degree, and the ever growing necessity to reduce operating expenses is causing the question of fuel to be very closely examined. Coal as commonly burned is an unsatisfactory heat agent, due largely to governing conditions which cannot be improved, but which are needlessly aggravated by improper handling of the fuel in the process of combustion. These facts are generally known and admitted, and yet an unaccountable apathy has allowed the wasteful methods to continue. Probably no factor in the cost of manufactures requiring large quantities of heat presents a more encouraging field for improvement and saving than that of direct fired coal furnaces.

That we may better realize what a small part of the value of the coal is utilized, I would here state that in average puddling practice only about 5 per cent. of the heat from the coal burned enters the iron. The remaining 95 per cent. passes off by the chimney or is lost in radiation. It is true, however, that oftentimes this loss can be reduced fully 25 per cent., by allowing the waste gases to pass through overhead boilers, and this is the usual custom in cases where the steam so generated can be utilized. In the best open hearth practice about 18 per cent. of the value of the coal is absorbed by the steel. Much of the heat is unavoidably lost, owing, as was previously stated, to the unsatisfactory conditions attending the combustion of coal, requiring, as it does, the heating of the combining air. Until other methods are discovered whereby the heat can be drawn from the fuel without the aid of air, or the necessary thermal energy to successfully treat the iron or steel can be applied through some other medium than ordinary combustion, as, for instance, electricity, we can hope to realize but a small amount of the heat energy employed.

Fuel exists in three forms—solid, liquid and gaseous. The limited quantity of liquid fuel available forbids it from replacing solid fuel to any great extent, and as we shall find later its increased cost and practical disadvantages will further tend to discourage its use, except in cases where it is particularly adapted, as, for instance, in connection with small fires requiring intense heat. If we are to improve on solid fuel we must turn to the gaseous form as presenting possibilities for superior economy. In referring to solid fuel we will limit our remarks to coal. With these introductory remarks we will now examine the subject in hand. I will aim to touch upon the following:

1. What is producer gas, as commonly termed?
2. How is it made?
3. In a general way, what are some of the principal advautages attaching to its use?
4. How will these advantages apply to foundry work, both iron and steel?

The Character of Producer Gas.—This can be either an air gas or a mixture of air and water gas. The latter or mixed gas is commonly employed. Such a gas is composed of carbon monoxide, hydrogen, oxygen, methane, or marsh gas, and sometimes ethylene carbon dioxide and nitrogen. These are present in varying proportions dependent upon the quality of coal used and the conditions of manufacture. In considering our second proposition as to how producer gas is made, we will get a clearer idea of what it consists.

The Manufacture of Producer Gas.—In order to gasify coal, the only requirements are a receiver to hold the coal and a supply of oxygen forced through the same under conditions which will maintain a proper incandescence of the fuel bed. The oxygen so introduced can be by the medium of air, either under natural or forced draft, or through the agency of water vapor, or both. When air is alone used the resulting gas is termed "air gas." As compared with other gases it contains the least amount of heat per unit of volume or weight. This is owing to the fact that for every pound of oxygen admitted in the blast $3\frac{34}{100}$ pounds of nitrogen are present. Nitrogen not only does not develop heat, but acts negatively by abstracting heat from the fuel to raise it to the temperature of the other gases. The best modern practice furnishes about one-fourth of the required amount of oxygen through the introduction of a steam blast. There are several standards for measuring heat; that usually employed in American practice is the British thermal unit, commonly abbreviated as B.T.U. It represents the amount of heat necessary to raise 1 pound of water from 39° to 40° F. The total heat developed by a pound of carbon in burning to the state of carbon dioxide (CO_2) is 14,500 B.T.U. If the combustion of the carbon is arrested and only transferred to the state of carbon monoxide (CO) there will be developed 4,400 B.T.U., or about 30 per cent. of the above quantity. This heat will be expended in 1, raising the coal to heat necessary to distill the gases; 2, in overcoming the internal forces incident to transforming heat from a solid to a gaseous state, known as the "latent heat of gasification" and, 3, appearing in the gas in a sensible form.

If only an air blast is used in blowing the producer it requires no calculation to understand that the heat evolved by the partial combustion of the coal tends to raise the fuel and gases to a high temperature, possibly approximating 1200° to 1500° F. This heat being in a sensible state is liable to loss through radiation, first in the producer and afterward in transmission to the furnaces, which are usually placed some distance apart. It is therefore desirable to place the producers as near the furnace as practicable, so far as the heat is considered. Questions of facilities for distributing coal to the producers and best arrangements for piping the gas throughout the works will, however, demand consideration. To remedy this possibility of loss the sensible heat in excess of what is required to maintain a proper incandescence of the fuel bed—say 600° F.—is utilized in dissociating water, thus changing its character from sensible to latent. In this form the gas can be transported with far less loss. Gas from bituminous coal, however, will suffer seriously if cooled below 300° F., owing to the breaking up of the volatile hydrocarbons, which will be deposited as tar. It might be well to add here that since there is required to dissociate water an amount of heat equal to that given off in the furnace by the combustion of the resultant hydrogen and combined oxygen, it is obvious that no claim can be made for any increase in the calorific value of the gas due to such dissociation. The effect of steam in preventing the hardening of clinker is another reason for its introduction in the blast.

When first introduced, gas producers used only an air blast, but as previously remarked, it is now customary to employ steam in connection with air. Ordinarily the air is drawn in by the steam jet, which is introduced usually under the grate bars, and under sufficient pressure to penetrate the ash and fuel beds. Surrounding conditions sometimes make it desirable to avoid the noise incident to a steam blower, in which case the air properly moistened can be forced from a fan blower. When applied below the grate particular attention must be given to guard against the blast becoming choked by an accumulation of clinker and being forced to the walls of the producer, the

point of least resistance. To secure good gas it is important that the blast be uniformly distributed throughout the fuel bed. Any clinker or other obstruction in the ash will tend to cause "blow holes" in the fuel bed, and by burning the gas at such points to CO_2 will very seriously impair the efficiency of the producer. This point is considered in the construction of the Taylor revolving bottom gas producer, which applies the blast through a central tuyere pipe at the base of the fuel bed. The result is a very uniform gas both as to quality and quantity.

The advent of natural gas has resulted in demonstrating many advantages accruing to gas firing, and has been the means of encouraging the introduction of producer gas in districts remote from the natural gas fields. As a matter of fact, it is being very rapidly adopted in almost all lines of industries involving the application of heat in large volumes.

The Advantages of Producer Gas.—The general inducements for using producer gas are cheapness of fuel, labor saved in maintaining separate fires, more uniform heat throughout the furnace; and when regeneration is employed it is possible to obtain a temperature 30 per cent. more intense than with coal directly fired. With anthracite coal in gas producers there is practically no soot, and the amount of ash should not exceed what is in the coal plus a half of 1 per cent. of the coal charged. With bituminous coal the amount of soot is very largely reduced and the ash practically what is in the coal. There are other points in favor of gas firing relative to combustion.

It might be asked, why can a pound of coal develop more heat by being transformed first into the gaseous state, as in a gas producer, and subsequently burned than would be the case if the same coal were at once consumed in the furnace from the solid state? To this I would answer: 1. The coal is more thoroughly burned in a properly designed gas producer than upon grate bars. Records of six weeks' duration of ordinary every day running with the Taylor type of gas producers above referred to have shown less than 0.2 per cent. of total coal charged to be in the ash. 2. It is possible with gas producers to get a more perfect combustion of the gases with less air than is used with coal fired on a grate. I have not thought it desirable to weary you with the chemistry of combustion, but will let a statement of facts suffice: To completely burn a pound of coal of average composition requires theoretically about 12 pounds of air; it is not only possible but it is true that very nearly these conditions exist in a properly constructed gas producer plant under ordinary care, whereas carefully conducted investigations abroad and also on the part of the United States Government demonstrate the fact that the average direct fired furnace will consume from 22 to 24 pounds of air per pound of coal burned.

It is true that in the case of some of the modern boiler constructions, as for instance the Babcock & Wilcox, it is claimed that perfect combustion is obtained on from 14 to 15 pounds of air, under forced draft, but these instances are so rare compared with average practice as only to serve to establish the truth of the statement that much more air is required to burn coal upon a grate than ought to be used if thoroughly mixed.

It is because the mixture is very slow in forming and most imperfectly accomplished that the surplus air is needed. Even with free oxygen present in the flue gases, indicating an excess of air, it is common to find carbonic oxide or partially consumed carbon also present, so it is evident that loss is taking place not only in heating the lot of surplus air to the temperature of the furnace, but also that unconsumed gases are being wasted.

To better understand these losses, let us assume a pound of carbon to be burned to carbonic acid (CO_2) and developing 14,500 B.T.U. The products of combustion will weigh about 12.6 pounds, and if they escape at a temperature of 550° F. higher than the atmosphere, or say at 600° F., will consume 1732 B.T.U., or about 12 per cent. of the heat value of the fuel. The balance, 12,768 B.T.U., will be used up in the furnace or lost in radiation and heat rejected in the ash. Now, instead of 11.6 pounds of air, let us use in burning the carbon 22 pounds, making 23 pounds of products of combustion. To heat this amount 500° would consume 3162 B.T.U., or nearly 22 per cent. of the thermal value of the carbon, and would leave but 11,338 B.T.U. available for furnace, etc. This indicates a loss of 10 per cent. of the value of the fuel. Again, if only 1 per cent. of the weight of the gas as it comes from the producer were allowed to escape as carbonic oxide a further loss of 2 per cent. of the total value of the fuel would result. If the temperature of the chimney gases were 1000° F. above that of the atmosphere, instead of 550°, as assumed, the loss due to the heating of surplus air would amount to 18 per cent. of the value of the fuel, instead of 10 per cent. Thus it appears that from 10 per cent. to 18 per cent. of the value of the fuel would be wasted in heating the surplus air within the range of temperature assumed. There is considerable loss, usually of carbon in the ash, from a direct fired furnace. Probably 4 per cent. of the fuel would be a conservative estimate for this loss.

We therefore have a possible saving in the use of gas producers over average practice in direct firing of from 10 per cent. to 18 per cent. due to heating surplus air, say 3 per cent. on account of incomplete combustion and 4 per cent. due to unconsumed carbon in the ash; in all a saving of from 10 per cent. to 25 per cent. dependent upon how bad the conditions are. We believe these figures are underestimated, and particularly when we consider heating furnaces, the majority of which discharge their gases at temperatures exceeding 1500° F. We have based our estimate upon carbon; with a coal rich in hydrocarbons the losses referred to would be larger, owing to the fact that hydrogen requires more air to burn than does carbon. Additional losses would further result from deposition caused by drafts of cold air chilling the volatile hydrocarbons when fresh coal is being charged.

Allusion has been made to liquid fuel. This is usually in the form of crude and fuel oil, the latter being the residue from the distillation of the former. As with coal, so there is a wide difference in the calorific values of the crude and fuel oils. If we compare simply the heating powers of coal and crude oil, of average thermal values, we find that a pound of oil is equal to about 1½ pounds of coal. But, because in practice the air supplied can be better regulated in burning oil than in coal, the comparative results are about as 1½ to 1 in favor of oil. This assumes the coal burned on the grate. As compared with coal consumed in a gas producer, the advantage of surplus air is in favor of the coal, owing to the fact that the hydrocarbons composing the oil require more air to burn them. Generally speaking, probably 1½ pounds of coal when gasified and subsequently burned would more correctly represent the comparative value of a pound of crude oil. With coal assumed at $3 per gross ton, and charging the cost of handling the coal and ashes in the operation of the gas producer, together with interest at 6 per cent. on a gas producer plant, the limit at which these figures would fix the price of oil would be about 1.7 cents per gallon. This limit in price would be considerably reduced by utilizing in this locality buckwheat coal, and when bituminous is more accessible, nut and slack, or even all slack. Apart from its expense, oil does not give the mellow heat obtainable with producer gas, but is rather very localizing in its character, being intense near the point of application, thereby rendering it extremely difficult to obtain a uniform heat throughout the furnace or kiln. If properly applied, it is quite possible to get good results, but generally at an increased cost over gas. In case of small fires, requiring high heats, oil is of special value, but wherever large volumes of heat are required, unless special conditions prevent, producer gas is far preferable.

Producer Gas in the Foundry.—The application of producer gas in connection with the drying of cores and molds of pipe castings has been for several years in successful operation at the Florence Iron Works, Florence, N. J. The chief saving is in being able to utilize an inferior grade of coal, being the No. 2 buckwheat. About two-thirds as much coal is required as when fired on a grate, and taken in connection with the reduced price of the inferior coal, there is a saving in expense of about 67 per cent. over former method. At the Camden Iron Works, Camden, N. J., producer gas is being used to fire ordinary horizontal tubular boilers. Although the evaporated duty of these gas fired boilers is not in excess of what can be obtained in direct firing, ranging from 7 to 10 pounds of water per pound of coal, under gauge pressure of 70 pounds per square inch, yet it is done with No. 2 buckwheat coal and with ordinary labor. Owing to defects in the gas main, which is under ground, the gas is in contact with more or less water, and is thereby robbed of 50 per cent. of its sensible heat, which reduces the evaporation accordingly. Probably the greatest benefit to be obtained from the use of gas in generating steam is the increased life of the boiler. There is no opening of doors as when charging coal, thereby subjecting the heated sheets to a rush of cold air and also causing a lot of gases to be chilled and deposited as soot in the tube. This results not only in the direct loss of the condensed gases, but the further loss due to the reduced efficiency of the boiler, owing to the accumulation of soot in the tubes. How serious this can be is given by the Babcock & Wilcox Boiler Company in their descriptive pamphlet as follows: "One-eighth inch of soot in tubes renders the heating surface useless, and $\frac{1}{16}$-th inch will cause a loss of 13 per cent. in fuel."

From previous remarks relative to loss of heat due to excess of air in

burning coal, we find that in the use of producer gas, with the chimney gases at 550° above the atmosphere, there is a probable saving of 10 per cent. in fuel. I would refer anybody desirous of studying into the matter to a very instructive and interesting article by W. H. Blauvelt, which appears in the December, 1894, number of *Cassier's Magazine*. It bears directly upon the subject of producer gas, as applied to boiler firing.

There is one more point to which I would call your attention, as presenting something of interest to the foundryman. It is the saving that can be secured by the use of gas engines. The best compound steam engines in every day running will require at least 2½ pounds of coal per indicated horse power per hour, and the average small high pressure engine will probably require nearer 10 pounds per horse power hour. Gas engines operated with producer gas will perform every day service on 1½ pounds of coal per horse power hour. This is being done at the works of the Otto Gas Engine Company, at 33d and Walnut streets, Philadelphia. I have been told by this firm that they are running their works for one week on the same amount of coal gasified in a producer as they formerly burned in one day when operated with steam. It is customary to use anthracite coal for gas engine work. The gas from soft coal cannot be cleaned sufficiently for their service.

Special points of interest, to which I merely allude, involving some of the physical advantages attaching to producer gas, are cleanliness in and about the works, freedom from the smoke nuisance, the concentration of all labor incident to the delivery and burning of the coal, as well as disposal of the ash.

Supplementing what has gone before, it may be of interest to give the average coal consumption in heating and melting of steel, when treated with producer gas:

Open hearth, 600–700 pounds of coal per ton of product.

Heating, 200–300 pounds from cold steel billets, dependent upon conditions.

Soaking pit work can be done with 38 pounds of ordinary Pittsburgh coal per ton of ingots heated.

Some discussion then ensued. Asked what method was employed to introduce the gas to the boiler, Mr. Prince replied with a description of the method by which the gas is applied under the boiler at the Camden Iron Works. The gas, as it issues from the gas main, located underground in the rear of the boiler setting, passes upward through a 6-inch pipe surmounted by a valve box, at which point the supply of gas to be burned under the boiler can be regulated. Near the top of this box, which is rectangular in section, there is attached an 8-inch wrought iron pipe about 6 feet long, which extends through the rear end of the boiler setting, and about 1 foot in front of the blow-off pipe. Inside of this 8-inch pipe there is placed one of 4 inches diameter, which is flush with the front end of the 8-inch and extends backward through the valve box, having at its end a sloping door, by which air can reach the interior of the gas column. The gas passes from the valve box through the annular space between the 4 and 8-inch pipes. Under the boiler shell are built two combustion chambers, divided by a central longitudinal wall, extending between the rear of the boiler setting and the bridge wall. The roofs of these combustion chambers are of 4-inch tile, about 6 inches below the boiler shell, and having the same curve. There is a 4-inch space between the outside walls of the boiler setting and the side walls of the combustion chambers, and below the chambers there are also longitudinal passages extending to the rear of the setting. Through these passages air is admitted, controlled by a slide valve attached to the face of the rear wall, and passes forward to the bridge wall, then laterally and upward into the spaces outside of the combustion chambers before referred to, then backward to an orifice opposite the end of the 8-inch burners, at which point the heated air is brought into combination with the gas as it issues from the burners, of which there are two under each boiler. The gases are almost entirely consumed within the combustion chambers, the products of combustion passing forward to the crown sheet, back over the roof of combustion chambers and out through boiler tubes in the usual way. Bricks are laid loosely on the grate bars and can be readily removed if occasion requires and the boiler fired in the usual manner.

In reply to a request for information in regard to the construction of a cupola in which iron was being melted by gas, Mr. Prince said: "I can refer to no case coming under my personal observation, in which producer gas has been successfully applied in this country in connection with cupolas. There are, however, several instances abroad in which good results have been obtained. In all these cases provision was made for utilizing the waste heat to preheat the air." "Alfred Wilson designed a gas cupola which consumed 2 cwt. of small coal or dross per ton of iron," This is quoted from "Chemical Technology," by Grove and Thorp, in which work is also described a more elaborately constructed furnace for melting pig iron, after the plan of open hearth practice.

In this latter type it is stated that "an average of 1.44 cwt. of coal per ton of metal charged into the cupola was the consumption in continuous working."

Regenerative Gas Stoves.

At the Buda-Pesth meeting of the International Congress of Hygiene and Demography, Mr. Frederick Siemens read a paper on the advantages of gas heating for apartments, and called attention to the availability of regenerative gas stoves for such work. The *Gas World*, in alluding to the paper, presents the following abstract translation thereof:

The rational heating of apartments is an extremely important question, hardly completely solved by any of the appliances in use. Heating ought to be cheap and convenient, and to require no skilled supervision; and it ought to conduce to comfort. If possible, it should be self-regulating, and should produce no direct evil, such as smoke. Most systems are too expensive; hot air is bad for the lungs, being dry; the air respired should be cool and moist. The English coal fire is too dear, though it is most comfortable, depending, as it does, entirely on radiant heat, which is Nature's method of warming us by the sun. But it vitiates the atmosphere, sometimes to an almost unbearable extent, and it requires a great deal of attention and of cleaning up. The German stove works cheaply; but it has hardly any radiant heat, and it produces upward currents of hot air, which afterwards fall down the cooler walls. On the other hand, the walls of the stove are never very hot; but still the air is heated, and we breathe hot air. Cast iron stoves are very simple, but very bad; for their outer walls are very hot, and the organic dust in the air is singed, with the production of an evil odor; and to this class belong all stoves whose heated surface reaches a temperature above 212° F. Such stoves are mostly used as auxiliary means of heating, for they become unbearable if kept constantly in use. Countries with long winters are found to tend to use stoves whose external walls are not fiercely heated; and low pressure hot water systems are the favorites for the same reason, though they are more expensive to work.

In Siemens' regenerative gas stove the radiant heat of gas flames is utilized. But the ordinary gas flame gives off only about 30 per cent. of its heat in the radiant form. This proportion can, however, be about doubled if we use the intensely white and bright flame of a regenerative burner; while the products of combustion carry off less heat with them. Besides, these products are largely robbed of their heat in warming the air supply of the flame. Mr. Siemens began working on these principles some 12 years ago, and in 1885 he took out his German patent. The consequence was a good deal of competition on the part of stoves partly with and partly without radiant heat, but all without the regenerative appliance. At first the regenerative stoves were not well received, partly because they were thought to use too much gas, partly because the flame, which was in sight, was too blinding. But since a pattern was shown at the Brussels Exhibition in which the flame was not directly visible, and in which the heat was reflected indirectly, the popular favor has returned to this class of stoves, though the matter has been complicated by a number of patterns being advertised as regenerative, or even as double regenerative, though they are not regenerative in the least.

Siemens' stove now consists of two parts; the lower a series of horizontal flames, fed with hot air, and out of sight, but reflecting from a curved metal reflector, which sends the reflected radiant heat horizontally along the floor level; and an upper portion (which may be dispensed with) containing an arrangement whereby ascending currents of air may be heated by the ascending products of combustion. The flames are supplied with air which has ascended behind the reflector, between this and a metal passage which takes the products of combustion first downwards and then up; and the upward tendency of this air supply itself makes a draught which is quite sufficient to work the stove, even though there be no chimney at all. Since the surface exposed in the upper part of the stove is very considerable, any air which passes through it is never exposed to a very high temperature, and is, accordingly, not charred. Water is also evaporated in the stove, so as to prevent the air becoming too dry. This upper part is an economical device; but if the most comfortable heating is desired, the upper part may be omitted, so that reliance is exclusively placed upon radiation of heat and reflection from the metal reflector. By this stove the feet are kept warmer than the head, which conduces greatly to comfort.

In the stove there is a contrivance for regulating the temperature. The principle of this is that when the temperature goes beyond a predetermined limit, water in the apparatus expands and presses down a cone which partly shuts off the gas; while if the room grows too cold, the cone is lifted and the gas flow increased. The apparatus can be adjusted to the temperature desired by means of a screw; and if there be any loss of water in the apparatus, the whole thing can be re-adjusted without delay or loss of time.

There is also a safety stopcock arrangement, in which the gas must be wholly shut off, or run to the kindling flame only, or run to the heating flames only, with a greater or smaller airway in the last case, at the will of the user.

Electric Wiring and the Fire Hazard.

[By Mr. F. E. Cabot, in *Engineering Magazine.*]

Perhaps no element among those which enter into the causes of fire and fire losses has caused more discussion and difference of opinion than electricity, since its introduction for light and power during the past decade. When the dynamo and its use to produce electric current first came before the commercial world, there was some distrust in this strange force, which the crude methods first employed did little to overcome. The march of progress was rapid, however, and within a short time the introduction of the incandescent lamp—"light without heat," as it was so often called—gave rise to a hope, never yet realized, that a method of illumination, which could be used under all conditions and in all places, had at last been discovered. Insurance officials throughout the country were delighted at the thought that the hazards of friction matches, of inflammable oils, of the contact of light-giving flame with inflammable gases and dusts in the air, were to be overcome by the use of the new light, and that no new hazard would follow in its train. In some parts of the country insurance companies went so far as to put a premium on its introduction, by reducing rates of insurance on certain classes of factories when lit exclusively by incandescent light. But as the introduction of electricity became common and its use was extended to all parts of the country and to all sorts of buildings, rumors began to arise of fires from some cause or causes hitherto unknown, where electric wires were run, until within the last two years the pendulum has swung in the opposite direction, and not only insurance officials, but the public, are inclined to refer to electricity as the prime factor in the great increase in the fire waste throughout the country. No sufficient proof has ever been given, or even offered, that this is the case, nor does the writer believe that up to the present time the use of electricity has been the only, or even the greatest, factor in the increase of loss by fire from which this country has suffered during the past ten years. Furthermore, there is little doubt that, with reasonable care of installation and properly designed apparatus, electricity can be made not only a convenient but a safe method of producing light and power wherever needed, and can be used in many places where other forms of light and power are unsafe and undesirable. Yet any one who will read the quarterly reports issued by Mr. W. H. Merrill, Jr., Electrician for the Chicago Fire Underwriters' Association and the Underwriters' Electrical Bureau of Chicago, will see that under present conditions the use of electricity for light and power adds considerably to the danger from fire. Mr. Merrill says: "Nothing approaching a complete statement of the country's fire loss from electricity has been secured, because we have less than 35 electrical inspection departments in the country, and because so many fires destroy all evidences of their origin. * * * No complete statistics can be gathered from this report, and no quotation should be given from it without the foregoing explanation." This summary shows that 475 fires, with a loss amounting to $1,415,610.25, were reported to him as having occurred in this country alone during the year ending October 1, 1894. This is approximately 1 per cent. of the fire loss for the year—a sum of sufficient importance to call attention to its causes and the means which may be properly taken to reduce it.

The writer believes that any one who cares to study the causes of fires started by electricity will be convinced that a very large proportion of these fires are from defects which would never have existed had the work of installation been done by men having a proper knowledge of the subject. He has no intention, in making this statement, of saying that the fault lies wholly or largely with the men themselves. The enormous strides which the development of this force has taken within the past ten years have made it necessary to employ, for most of the work, men whose whole knowledge of the subject has been and is most superficial. All the knowledge which workmen, or, in fact, any considerable number of persons, had on the subject was derived solely from familiarity with battery currents, and very naturally the means which had been found entirely sufficient to control these currents were still believed to be adequate. Of course, it took but a short time to show that such means would no longer suffice, and efforts were at once made to secure greater protection. There can be no reasonable doubt that, had the development of the purposes to which electricity could be applied, and of the means for producing and supplying the current adequately and economically, been, even for a time, checked in its advance, sufficient means of control would have been developed. But for each step in the advance of protection, the art advanced two; higher pressures were produced, machines capable of developing larger quantities of current were built, and the number of uses to which the current could be put were multiplied. Even within the past year there has been a decided tendency to increase the size of dynamos and the pressure at which they are intended to be operated, although no corresponding advance has been made either in insulation or in the method of control.

In another way, too, the advance of electricity has increased the danger of fire. Through the use of the so-called low potential system o lighting, the dynamo current now goes into every mercantile building and into almost every house in the larger cities throughout the country. Under ordinary conditions the current used for this kind of lighting makes itself known only through the light of the incandescent filament, for, though a certain amount of heat is developed in the lamp, it is not sufficient to attract attention. As a result, people felt that this current and the "light without heat" were perfectly harmless, and that the wires and lamps could be put anywhere with safety, so that the poorest forms of insulation were considered sufficient and the fusible cut-out was thought to be a perfect form of protection. In the same way the lack of knowledge and consideration of the danger from this source led to carelessness in construction work, and allowed the employment of incompetent workmen without proper supervision.

There can be no doubt that a very large proportion of the fires from electrical currents would never have occurred, if all the work had been first rate. Any one who has had to do with work of this sort knows that there are to-day many electric light plants, with none of the better forms of protection or insulation, which have run for years without a suspicion of danger from fire. In these cases careful workmanship supplied the want of better materials.

In order to understand clearly why there have been so many fires, it may be necessary to separate the ways in which they occurred, and to consider certain of these by themselves. Of the 475 fires referred to in Mr. Merrill's summary, 59 were from contact between conductors carrying electricity for light and power, and wires intended to carry only "battery" currents. These wires are, as a rule, only of sufficient size and insulation for their normal use, and, though much has been said upon the subject, are to a very considerable extent without devices providing for automatic opening of the circuit whenever a current of great pressure or quantity passes over it. Now, there can be no doubt that every one of these 59 fires could have been prevented by the use of proper fuses on the battery lines where they enter buildings, and by a little more care in the construction and maintenance of such lines. The telephone companies in many parts of the country are showing how this work should be done, as they now realize how important it is that all danger of fire from this cause should be reduced to a minimum for their own protection; and in some large cities, where public sentiment against overhead wires has made itself felt, other companies having overhead "battery" lines are taking the necessary steps to protect their lines; but, in a great majority of cities in the United States where electric light and power lines exist, much still can and should be done to lessen this danger.

One hundred and ten fires were from "grounds"—that is, from the diversion of the current from its proper conductors to other substances making electrical connection more or less perfectly with the earth. It is fair to assume that reasonable care in the placing and maintenance of these conductors would have prevented one-half, at least, of the fires and losses from this cause. Again, nine fires resulted from the use of the grounded street railway currents for commercial lighting and power, in spite of the objections urged against its use by insurance inspectors, which objections were for the most part based on the experience acquired early in the use of dynamo currents for lighting and power, and to which attention was called as early as 1882, by Mr. C. J. H. Woodbury, then in the employ of the Boston Manufacturers' Mutual Fire Insurance Company, who was, so far as the writer knows, the first person in this country to take up the hazards of electricity from the insurance point of view. He clearly pointed out at that time that one of the chief hazards then existing in the use of dynamo currents was that arising from the employment of the earth or grounded conductors for the return current. In his book, "Fire Protection of Mills," published in 1882, Mr. Wood.

bury says: "Each machine should be used with a complete wire circuit, and connection of wire with pipes, or the use of ground circuits in any other method, is absolutely prohibited." This rule has been published in every set of rules issued in the interests of insurance since that time. Yet the writer has been forced more than once to listen to an elaborate argument to prove that the method objected to, which, as Mr. Woodbury showed, was unsafe and therefore undesirable from the insurance point of view, was one which it was perfectly proper to use, even with the currents used on railways, which are of high voltage and much greater in quantity than anything known when the first insurance rules were issued. These nine fires can all be justly charged directly to the managers of the power plants furnishing such current, who were willing to jeopardize life and property for the sake of the small amount of money to be derived from the sale of such current for use in mercantile or residence buildings; or, if they plead that they did not realize the danger to others, then this loss should be charged to those who supplied the machines and apparatus for generating this current. Such persons must have had ample opportunity, through insurance rules, if in no other way, to realize the danger which would surely follow, and were bound by the common laws of humanity to give this information to all purchasers of their apparatus.

There is another way in which these grounded circuits of large volume and high potential are liable to increase the fire loss, and that is through what is often termed the "return" current passing through the earth. When the grounded trolley circuit was first used, it was thought that the earth would furnish ample capacity for the return circuit, and that no wires would be needed for this purpose. It took but a short time, however, to prove the fallacy of this reasoning. Reports began to appear in the newspapers of shocks received from water pipes and gas pipes, and of motors run by attaching a wire to different pipes or grounded conductors within the same building. These reports were at first laughed at and believed to be erroneous, but in the course of time the attention of insurance officials, officers of telephone companies, and city officials in charge of water works, was drawn to certain strange phenomena, and accurate tests were begun. These tests at once showed that the earth under normal conditions was far from being an adequate conductor for the current necessary to operate large street railways. The West End Street Railway Company, of Boston, found a drop of potential between the power house and parts of their longer lines of considerably over 50 volts. A road in Pennsylvania, whose power house was located directly on a river, and whose line ran near the same stream, built their line without return wires, and trusted to ground plates in the river to furnish the balance of the circuit. Yet, when the dynamos were started and an attempt was made to operate the road, it was found impossible to obtain current enough to run one car.

As this investigation was carried on, new and striking facts were noted, and it was found that the current, for which the *earth* was to provide a circuit, was passing into all metallic pipes laid in the earth near the path of the current, and was using them in its return. Currents with a pressure of 8 to 10 volts and a quantity varying from 5 to 25 amperes were shown to be passing along gas and water pipes within the same building. A difference of potential of from 10 to 20 volts was found between the street car rails and hydrants on water pipes within 20 feet of them. A spark was seen to jump between the ends of the rails laid on a swinging drawbridge, when the draw was turned, and on measurement a current of 500 amperes at a pressure of 15 to 17 volts passed over the wire put in to connect the ends of the rails. The writer has every reason to believe that within a short time current of this nature has passed between the gas and water pipes in a building in Boston in sufficient quantity to melt off the soldered connection of the gas meter. Such statements may seem unreasonable, but, except in the last case, they are capable of definite proof, and have been recognized as reliable by competent engineering experts.

Now, the effect of currents of great volume and potential, wandering as it were through the earth, is certain to make itself felt, as it is already showing the beginning of its work in the destruction of metallic pipes and conductors in the earth. This destruction, though slow, is absolutely sure wherever pipes, or uninsulated underground conductors, form a part of the railway circuit; for electrolysis depends wholly on the amount of current passing out of a conductor and into another of a different conductivity. The reply will probably be made that proper bonding of rails and ample return wires in the ground will prevent any such results; but bonds often break, and connections underground are constantly weakened by corrosion and are liable to give way, and, when they are defective, the current must find another path. Moreover, there is nothing more fixed than the law that in a divided circuit the current divides in the inverse proportion of the resistances of the paths by which it goes, and, no matter how large an amount of return wire is provided, some part of the current will certainly go through the earth, and will have an injurious effect on the metallic pipes contained therein. Sooner or later this effect will show itself, in deterioration of such pipe, and, so long as the single trolley grounded circuit is used, there is no way of escaping from it, unless an alternating current can be used. Let us hope that an efficient substitute for the present system will be found before these effects become serious.

Now, with reference to the possibilities of overcoming the dangers which arise from the use of electricity on metallic circuits, it is reasonable to believe that all which have thus far been encountered can be overcome. That this may be accomplished as speedily and as completely as possible there must be thorough co-operation on the part of all who encounter the problems brought forward by the increasing use of electricity. It seems desirable at this point to say a word as to the work which the insurance companies throughout the country are doing to solve these problems. The work which Mr. Woodbury did in this direction for the Associated Mill Mutual Insurance Companies, to which allusion was made above, roused the interest of insurance men throughout the country, and, as a result of his work, insurance organizations have endeavored to lay down rules by which the hazards introduced by the extended use of dynamo currents could be lessened, even if not entirely overcome. Their efforts have been met by the men who were engaged in the manufacture and sale of devices and apparatus for this work in very different ways. On the one hand, the insurance inspector has been received as a friend who was working for the best interests of all concerned; on the other hand, he has met opposition of the most bitter kind. No one realizes better than the writer that the first work of any man who undertakes the problem from the insurance standpoint has been, as a rule, crude. In fact, until recently, this has been almost of necessity the case, for each man has been obliged to work out each problem with little assistance and under circumstances unfavorable to mature consideration of the result. Practically no literature on the subject existed, and, until within a short time, there has been no way in which the experience gained by one inspector was, or could be, made useful to others. As a natural result, the rules in force in different parts of the country differed in many points, and were, in part at least, the result of rather hasty judgment. Within the past two years, however, and as a result of the efforts of a few earnest inspectors, this difficulty has been overcome, and means are at hand by which the reports of their work and the experience thus gained are brought together, and uniformity of practice and rules is made possible.

The insurance companies have provided suitable means for testing apparatus, conductors and devices for electrical work, and have thus afforded an opportunity, to anyone who will ask for it, of knowing something, at least, of the safety of any new material or device before it is put upon the market. It remains to be seen how far their efforts will be seconded by those interested in the other side of the problem, and to what extent engineering experts, architects and the public at large will co-operate. If their assistance can be gained, if manufacturers will avail themselves of this opportunity for test, if experts called upon to choose the best forms of apparatus will use the information thus made available, a great work will have been accomplished. The insurance interests have taken up the problem for their own benefit, but are only too glad to allow the public to profit by the knowledge thus acquired. It is in this way alone that the best results can be obtained.

The other important factor, which can only be removed by education, by a better general understanding of this great subject, is the danger arising from the employment of unskilled and incompetent workmen. When the work of placing and arranging wires, switches, motors, lamps and the many other details of an electric light or power system, is done in a thorough manner by men who have been properly taught, the number of fires caused by electricity will diminish. When architects and engineers realize that a circuit for this purpose cannot be safely put into any space which chance alone provides, and that as much energy can be conveyed through a copper wire the size of a pencil as through a large steel shaft, then good workmanship and proper devices will make safety possible, and the demand for good work will drive incompetent men from the field. Much has already been done in this direction, but much remains still undone. First cost alone is too much considered, and it is only through a better general knowledge of the subject that the desired end can be reached. Let the facts be known, even if some forms of apparatus have to go out of the market. The good of the public is, in the end, the good of those directly connected with the development of this great power, and no small or temporary delay will be a disadvantage, if through it the safety of life or property is gained.

How to Extinguish an Oil Fire in a Cellar.

Mr. A. S. Wall, Chief of the Toledo (Ohio) Fire Department, writing on the subject named in the heading, says:

Although petroleum was known in classic times to the Persians, Greeks and Romans, it was not until as late in our own time as the year 1860 that it was utilized for commercial purposes. To-day, in America, crude petroleum enters into the field of commercial enterprise to the extent of more than 40,000,000 barrels per annum, and the exports of its products amount in value to upwards of $50,000,000 a year.

With a commodity of so vast proportions offering peculiarly dangerous elements of combustion, entering so largely into our daily domestic life, we may well pause to investigate the science of extinguishing oil fires, with which we are so often called upon to do battle.

Oils are divided into three general classes—mineral, animal and vegetable. Of the very many oil products of petroleum, each has its peculiar characteristic in relation to fire test and flashing point of temperature. The best kerosene oil will flash when heated to 113° F., while if we add 1 per cent. of naphtha, the flashing point is reduced to 103° F.; and, by adding 2 per cent., it is reduced to 92°; 5 per cent., to 83°; 10 per cent., to 59°, and 20 per cent., to 40° F., and so on through all the oil products of petroleum with their fanciful names, each varying more or less in its characteristic according to its chemical condition.

Turpentine, alcohol, ether, chloroform and mineral lubricating oils are all liable to explosion when heated to the flashing point if in closed receptacles.

Linseed oil, lard oil, cottonseed oil, fish oil, etc., are not liable to explode under a very high temperature unless largely adulterated with mineral oil. Linseed oil requires a temperature of 260° before it takes fire.

The product of flame is carbonic dioxide, or, as more commonly known, carbonic acid gas, and where carbonic dioxide exists in sufficient quantity to displace the air, fire cannot exist, as it is absolutely necessary that to exist fire must be supplied with atmospheric air or oxygen to feed it, as flame cannot exist in its own product. This fact may be illustrated by the simple experiment of inverting an ordinary pail over a burning gas jet. It will be seen that in a few seconds of time the flame in the process of combustion having filled the space within the pail with carbonic dioxide, the flame being thus deprived of air or oxygen to feed upon, extinguishes.

Practical experience has taught us that water is not effective in extinguishing oil fires. One case fresh in my memory: A gasoline explosion occurred in a cellar. Water was poured into the cellar in large quantities, which only served to aggravate the flames, the oil being lighter than water, rising to the top of the water and burning as fiercely as ever. It was not until the chemical engines could be brought into service that any success could be had in extinguishing the flames. However, after this had been accomplished, water was used successfully in reducing the temperature and preventing the re-igniting of the oil.

Another instance: Several barrels of kerosene oil and a small amount of benzine were stored in a cellar. Fire started very near to an elevator shaft and a staircase, to both of which the fire communicated, and shooting up the shaft, quickly reached the roof. Water served to extinguish the fire in the stairs, shaft and roof, but it was necessary to bring into service the chemical engines to extinguish the flames of the burning oil. Water, being much more dense in gravity than oil, sinks to the bottom, does not displace the air, and consequently has no effect towards extinguishing the flames. However, after the oil flames have been smothered, water may be used to advantage to reduce the temperature below the flashing or igniting point.

While the water tower, aerial ladders and other appliances have been provided to reach the higher stories, the cellars have been lost sight of or neglected. Often much valuable time has been lost in our efforts to locate the seat of fires in cellars. How then may oil fires in cellars be most successfully battled?

It will be seen that to extinguish an oil fire in a cellar means should be taken to displace the air in the cellar by some means that does not support combustion; an element in which flame cannot exist.

Thanks to the knowledge of chemistry and modern sciences, an element has been discovered and placed within our control in which it is impossible for flame or fire to exist. How may this element—I refer to carbonic acid gas—be made use of to the best advantage? That will depend entirely upon the conditions that confront us. In no two cases are the conditions ever alike. In an open cellar, if carbonic acid gas be thrown in, it immediately sinks, being of gravity denser than air, displaces the latter, precluding the oxygen from feeding the flame, and the latter of course extinguishes.

If in cellars with outside approaches, and chemical engines may be brought into service, they accomplish the end in like manner. In a cellar with outlets only through the building, the desired end may be reached first by supplying means to close up all openings and thus make the cellar practically air tight, in which condition, of course, flame could exist only for a few seconds. There may be also in all cellars storing oil combustibles local equipments of pipes, tanks, etc., similar to our automatic sprinkler systems, with the tanks arranged precisely upon the plan of our chemical engines and so equipped with thermostats that at a given rise of temperature the acid is dumped automatically, the solution formed, and the gas and solution at once fill the cellar. A local or connected alarm may also be made to ring by the same action.

Like all automatics, however, the efficiency of this equipment would depend largely upon its frequent, systematic and intelligent inspection. An equipment of this kind might be materially simplified if cylinders filled with carbonic acid gas could be used instead of those containing water, soda and sulphuric acid; but this difficulty confronts us: In the storing of the gas in cylinders, the pressure would necessarily be so great, that upon being liberated it would solidify and thus fail of its object. I deem the suggestion worth mentioning, however, and leave the matter in the hands of the scientifically inclined for further evolution.

As a precautionary measure, also a system of open pipes might be laid from the cellar out to a safe distance, so that if needed, the chemical engines might be attached and the necessary gas be driven into the cellar despite the intense heat that might prevail. Portable pipes may also be carried upon our trucks for like purposes.

In conclusion I desire to say, that in following our chosen calling, precaution is one of the first essentials, emergencies constantly confront us, the intelligent anticipation of which will largely determine the measure of our success.

I want to say one word to the legislature and executive departments of every city in the land: Don't be parsimonious in the expenditures for the equipment and the encouragement of your fire departments. They will be quick to appreciate your liberality and will repay you tenfold.

On the Estimation of Sulphur in Pyrites.

[Contributed by Prof. G. Lunge to the Proceedings of the American Chemical Society.]

Under the above title Mr. T. S. Gladding published, in the *Journal* of the American Chemical Society, several modifications of the wet assay of pyrites which call for some comment on my part, since these modifications purport to be improvements on my method, contained in the "Alkali Makers' Handbook," and extensively employed in all countries.

Some of Gladding's modifications are of a less important character, and these can be passed in review very briefly. He does not, like myself, test the sample with its natural moisture, estimating the latter in a special sample, but he dries the whole sample and weighs it out in that state. He employs a whole gram of pyrites, I only half a gram; and I do so purposely, because the washing of the precipitates is much easier, and consequently the results are more reliable with the smaller than with the larger quantity. In lieu of the mixture of acids employed by me (3 volumes of nitric acid of sp. gr. 1.42, and 1 volume of fuming hydrochloric acid), Gladding decomposes the pyrites with a solution of bromine and nitric acid. The prescription for that solution is not correct as printed, for 75 grams of potassium bromide cannot possibly be dissolved in 50 grams of cold water, or anything like that quantity; but this may be a clerical error, which does not matter very much, as ultimately the solution is diluted to 500 cc. I will say at once that the bromine solution works well, but no better than the acid mixture according to my prescription.

A more important modification is the following: It is well known that in the presence of iron the precipitate formed by barium chloride in a solution of sulphates cannot be freed from iron, and that the results of the estimation of sulphur in this case are too low. In my publication of 1879 (*Ztschr. anal. Chem.*, 19, 419) I found on the average 0.19 per cent. too little sulphur, unless the iron had been previously removed from the solution. Fresenius has also worked on this subject, and Jannasch and Richards, in 1889, completely elucidated it by proving that a double sulphate of barium and iron was formed in this case. Gladding gives a similar explanation, without mentioning the more complete investigations of his predecessors, which would have saved him the trouble of working out the matter for himself. I had already

long ago dealt with that difficulty by proposing, in 1889, that method which was afterwards embodied in the "Alkali Makers' Handbook,"—viz., precipitating the iron by ammonia, washing the ferric hydroxide, and precipitating the sulphate in the filtrate by barium chloride. Gladding asserts, however, that "the most careful washing failed to wash out all the sulphur from the ferric hydroxide," and he therefore proposes to wash the hydroxide as well as possible, and to dissolve it afterwards in diluted hydrochloric acid, thereupon treating that solution with barium chloride; evidently with the tacit assumption that the small quantity of sulphide present in that solution is accurately enough estimated as barium sulphate, in spite of the large quantity of iron present. But that assumption is far from self-evident, nor does it actually represent the truth, as we shall see.

It is quite evident that Gladding, although he knows and quotes the "Alkali Makers' Handbook," and although he entirely adopts the prescription given there (p. 93) for the precipitation of the ferric hydroxide, which deviates not unessentially from those previously given by Fresenius and others, has not completely followed the instructions for the washing of the precipitate given immediately after in the following words: "Filter hot, and wash on the filter with hot water, avoiding channels in the mass, but so that the whole precipitate is thoroughly churned up with the water each time." Many hundreds of pyrites tests made in my own and other laboratories have proved that by following the above instructions the washing of the ferric hydroxide is accomplished in from half an hour to an hour, that the number of washings need not exceed five, and the bulk of the liquid, apart from the original filtrate, need not exceed 100 to 150 cc., and that no trace of sulphur is left in the ferric hydroxide, as evidenced by drying the precipitate, fluxing it with pure soda, dissolving it in water, and testing the solution for sulphate. It is true that the students in my laboratory have sometimes failed to get out all the sulphur, but in every case through having washed in the usual way, instead of that described above; and the same men have succeeded in every case after their attention had been drawn to this point.

There is another difference between Gladding's and my own manner of proceeding. I prescribe heating the solution of the sulphate to the boiling point, as well as that of the barium chloride, adding the latter to the former all at once, allowing to stand for half an hour only, and then at once filtering and washing while the liquid is quite hot. I had convinced myself that under these circumstances the precipitate filters most easily, and no barium sulphate whatever subsequently separates from the filtrate. Gladding, however, not merely adheres to the old and useless prescription of letting the liquid stand over night after the precipitation, but he adds to this a novel and most tedious way of effecting the precipitation—viz., adding 50 cc. of barium chloride solution quite slowly, one drop per minute. This will take about an hour, instead of a few seconds, as in my method.

I considered it my duty to find out whether the method recommended by Gladding is better than mine, or inferior to it, or equivalent with it; and in the last case, which of the two is easier and quicker to execute. For this purpose a sample of Spanish pyrites was selected which was triturated as usual and mixed in the most careful manner. The tests were made by one of my demonstrators, H. von Keler, under my constant personal supervision. First of all the sample was tested exactly according to the method laid down in the "Handbook," with the following results: 50.17, 50.42, 50.20, 50.23, 50.19; average, 50.24 per cent. The insoluble amounted to 1.42 per cent.; the moisture to 0.47 per cent. I abstain from reducing the percentages to the dry state, as being unnecessary in this case.

As the next step, a number of samples were decomposed by Gladding's mixture of bromine solution and nitric acid. We found his prescription in this item to be perfectly correct; it is not feasible to hasten the process (which is much lengthier than that used by myself), for instance, by filling the water bath from the first with hot water. Any attempt to do such a thing ends in an over-violent reaction, and a loss by spurting and separation of free sulphur. We tested, of course, our bromine and potassium bromide, and found them quite free from sulphuric acid.

Three of the samples thus decomposed, according to Gladding, were precipitated exactly according to his method (1 hour's precipitation, 12 hours' settling), another three samples according to mine (precipitating all at once and filtering after half an hour). The results were:

Gladding's Method.	Lunge's Method.
50.24	50.24
50.24	50.22
50.30	50.28
50.26	50.25

We see that both methods of precipitation give identical results, and these also entirely agree with the tests made from the first according to the "Handbook" method—viz., 50.24. The conclusions to be drawn therefrom are: 1. Since both methods of precipitation yield the same result, my expeditious method of precipitation and filtration, which, inclusive of washing, takes about an hour, is preferable to Gladding's method, requiring about 12 hours. 2. Since Gladding's bromine method for decomposing pyrites yields results identical with that prescribed by myself, there is no reason for abandoning the latter and adopting a more tedious method, unnecessarily employing such a disagreeable reagent as bromine.

I understand from a private communication of Mr. Gladding's that he attributes the greatest value to his manner of precipitating the barium sulphate, and that, in his opinion, by operating in my way barium chloride is always carried down with the sulphate, making the results too high by 0.20 to 0.40 per cent. It would have been most remarkable if that point had been overlooked in the many thousands of tests made according to my methods by perhaps a hundred different chemists; but in order not to incur any reproach, I had this point put to another searching investigation. Mr. W. Jackson made five most careful tests of another sample of pyrites, decomposing and otherwise treating them absolutely in the same way, but making the precipitation in two cases by Gladding's, and in three cases by my method. The results were:

Lunge's Method.	Gladding's Method.
50.59 per cent.	50.60 per cent.
50.63 " "	50.66 " "
50.56 " "	....
Average, 50.59 " "	Average, 50.63 " "

This affords another thorough refutation of Gladding's assertion.

In all analyses made up to this point the ferric hydroxide had been precipitated and washed five times, exactly in the way described by me; in every case it had been afterwards tested by fluxing with soda, but no trace of sulphur had ever been found. This furnished an additional (although unnecessary) proof that Gladding's assertion in that respect is equally unfounded, and that the treatment described by him (dissolving the ferric hydroxide in hydrochloric acid and precipitating by barium chloride) is quite useless, when observing the precautions in washing, pointed out by me. Still I thought it advisable to find out how Gladding's process would work in cases where, by some mistake, a little sulphur had been left in the hydroxide, and I grant that in important cases the latter ought to be tested in some way or another for any sulphur left behind. I further grant at once that in this case Gladding's method, as described, is more expeditious than mine: drying the ferric hydroxide, detaching it from the paper, mixing it with pure sodium carbonate, fluxing it in a platinum crucible (in such manner that no sulphur from the gas can get into the mass, *e. g.*, in a hole made in asbestos cardboard), dissolving in water and precipitating the sulphur by barium chloride. It is hardly necessary to say that I did not choose this plan without first considering the very simple method described by Mr. Gladding; but I rejected it, since Fresenius had proved that barium sulphate is very distinctly soluble in an acid solution of ferric chloride. But as Gladding now asserts that the direct solution of the ferric hydroxide in hydrochloric acid yields accurate results, it became incumbent upon me to examine this statement.

Eight samples of our pyrites were decomposed, and the ferric hydroxide was precipitated under absolutely equal conditions of dilution, temperature, and quantities of reagents. The washing was purposely not continued as far as it ought to have been; and as some previous experiments had shown that no uniform degree of exhaustion can be attained by incomplete washing, we estimated in all cases the *total* sulphur, separating, of course, that which was found in the filtrate and that which was left with the ferric hydroxide. Four of the eight samples were treated by Gladding's prescription, and four by my own system. The results were:

Lunge (fluxing with sodium carbonate).			Gladding (dissolving in hydrochloric acid).		
Filtrate.	Precipitate.	Total.	Filtrate.	Precipitate.	Total.
49.64	0.60	50.24	48.98	1.03	50.01
49.36	1.01	50.37	48.84	1.39	50.23
49.07	1.21	50.28	49.02	1.07	50.19
49.25	1.04	50.29	49.30	0.73	50.03
Average,		50.29	Average,		50.09

This proves that Gladding's method does not, in this particular, give accurate, but low results (by 0.20 per cent.); with less complete washing the discrepancy would evidently have been even greater. The total sul-

phur found by my process, on the other hand, agrees quite satisfactorily with the correct analyses quoted before.

The final conclusion of this investigation must be: That in most points Gladding's method is correct, but in not a single case more so than my method; his modifications can not be approved, as they greatly lengthen the time required for the analysis, without any corresponding advantage whatever. In one point which forms the principal novelty in Gladding's process, he is decidedly wrong. It is not true that it is unavoidable to leave any sulphur in the ferric hydroxide; on the contrary, this is very easy to avoid. If it has, after all, happened by incorrect manipulation, Gladding's plan will not get out all the sulphur, but my plan (fluxing with soda) must be adopted.

I have shown that there is not a single point recommended by Gladding, in deviation from my method, which is fit for adoption, and I must conscientiously advise my brother chemists to adhere to the method just as I have laid it down in the "Alkali Makers' Handbook."

In conclusion, I would add that I have also tried the method recommended by F. Johnson (*Chem. News*, 1894, 70, 212), omitting to precipitate the iron, but reducing it by sodium hypophosphite to the state of protochloride. Even when working precisely as described by the author, the results were so widely off the truth, that I can make nothing whatever of this plan.

Mr. Charles F. Brush on the Infancy of Electric Lighting.

Mr. Charles F. Brush, of Cleveland, O., when called upon for a few remarks at the Cleveland convention of the National Electric Light Association, gave some interesting facts on the early history of electric lighting, with which he was so conspicuously identified. He said:

I will begin by calling your attention to the fact that dynamo electric machines for electroplating antedated by a considerable period the use of such machines for lighting purposes. This is interesting from an historical standpoint, because when I invented compound field winding for constant potential, now so generally used in lighting and power transmission, I applied it first to plating machines. That, I believe, is not generally known, and may therefore be interesting. Some of you will remember that all of the early Brush arc lighting machines were single lighters. Two of these machines were exhibited in the summer of 1877 at the Franklin Institute in Philadelphia. It was soon after that when we sold a single lighting machine to Dr. Longworth, of Cincinnati. This was one of the very first, if not the first sale of a Brush arc lighting machine. It was late in 1877 or the very beginning of 1878, and the doctor paid cash for it, like a little man. I hear these things are done differently now. At any rate, I went down to Cincinnati to show the doctor how to run that machine, and one evening while I was there he exhibited the light from the balcony of the building in which he lived, on one of the principal streets. It was a 4,000-candle light, and, of course, it attracted a large crowd of the natives, and every man in that crowd was ready and willing and anxious to tell his neighbors all about it. I mingled in the crowd for a time to hear the comments. I found one man who had collected quite an audience about him. He called attention to the solenoid at the top of the lamp. He said: "That is the can that holds the oil," and, speaking of the side rod of the lamp, "That is the tube which conducts the oil from the can to the burner." He did not say anything about electricity at all—a little oversight that was not noticed by his hearers, and it was all right.

These early single light machines were quickly followed by two and four light machines; that is to say, machines adapted to furnish two or four separate, distinct currents, each adapted to run a single arc light. Several of these machines were sold during the season of 1878 for lighting stores and shops. Among others, Mr. Wanamaker, of Philadelphia, bought a number to light his store. One of the earliest of these four light machines was exhibited at the works of the Union Steel Screw Company in this city to a number of invited guests. One gentleman on that occasion looked the whole apparatus over very carefully, perhaps a half hour, sized it up, and then, pointing to the line wire, he said to me, "How large is the hole in that wire that the electricity flows through?" Another gentleman, one connected with the screw company, observed the machine running for perhaps five minutes in complete silence. Then he had fully digested the whole thing and was ready to tell me all about it. He said, "The electricity in that thing is generated by that revolving business there, rubbing the air up against these iron blades [meaning the field magnets], just as you get sparks when you rub a cat's back." I raised the objection that while that was a good theory, it did not fully meet the facts; but he would not hear anything from me. He said, "The whole thing is plain. If you should run that machine in a vacuum where there is no air, you could not get any electricity."

The year of which I am speaking—1878—was memorable in the history of electric lighting. It was during that year that I had the great pleasure and good fortune to invent and develop and commercially introduce the modern series arc lamp with the shunt coil. It was this invention which first made arc lighting from central stations commercially possible, and I think it may justly be considered as marking the birth of the electric lighting industry of the world to-day.

One of the first instances, I think quite the first instance, of the use of arc lighting for purely commercial purposes, was in our little public square in this city. Twelve lights were carefully installed in the park on high, ornamental poles. The lamps used were of the ordinary so-called 2,000-candle power. While we were installing this plant in the public square a great deal of interest was manifested in the installation by the public, and on the occasion of starting the lights our little park was packed from side to side, and it was evident that many of the people expected a blinding glare of light, as evidenced by the fact that many of them had provided themselves with colored spectacles or smoked glass. Of course, there was a general feeling of disappointment at first in this respect, although every one was ready to admit he could read with perfect ease in any part of the square. After a few weeks, when the novelty had worn off and the people had got tired of staring at the arc and had time to see how nicely the little park was lighted, the general verdict was that those electric lights in the park were a pretty good thing after all, and that is the general verdict everywhere.

Of course, we had lots of trouble in the early days with carbons. The history of the carbon business is peculiar. Our first carbons were crooked, of course, and were soft, and had high electrical resistance, and burnt out rapidly, and were very expensive. To decrease the electrical resistance and prolong the life of the carbons, we electroplated them with copper, which is still done. This little scheme of covering the carbons with just enough and not too much copper was the only easy invention that it was my good fortune to make, and it paid fairly well, considering the effort involved, which was mighty small. It yielded, if I remember, something like $150,000 in cash on royalties before the bottom fell out of the carbon business. They were sold at the the rate of $240 a thousand. I say at the rate of $240 a thousand, because nobody ever thought of ordering a thousand carbons at once. They could not use them up in a generation. Fifty or a hundred was considered a fair order. As the business increased a little, we were able to reduce the price of the carbons, and we did reduce it at one step to $150 a thousand. It was at a loss for a time, but then we held our own and afterward made a little money. We subsequently reduced them from $150 to $62.50, on the theory that cheaper carbons would stimulate the growth of the electric light industry, and our theory was proven correct. Their use was stimulated and the business increased enormously, so that while we lost money on the carbons for a good while at that price, later we made a handsome profit at that price. Others seemed to grasp the situation about that time and competition sprang up, and it knocked the profits of the carbon business all to pieces.

Incandescent Lighting by Gas.

The *Gas World*, in a reference to an article by Mr. H. Lux on the above subject, notes that he points out there is now scarcely a week without the alleged discovery of a new incandescent gas burner, or the exploiting and advertising thereof; and the share market has been subject to strange fluctuations when particular firms took up these inventions. But this enthusiasm has now to a great extent cooled down. The curious thing is that so little is to be seen of these new lamps in practice. Fahnehjelm, with his magnesia and chromic oxide, was the first to make an advance on the old Drummond light, with its lime, or, later, zirconia; he used the Bunsen flame instead of an oxy-hydrogen mixture. Auer von Welsbach followed in the same line, and got a maximum effect by using the rare earths. But to get a maximum effect two things are necessary; a maximum proportional surface exposed, and a minimum thickness of the material heated. By these means heat is not wasted in interior heating of the filaments. On these lines Dr. Auer arrived at his well-known hood. But this hood is very sensitive to vibration; not nearly so much so now as, say, a year ago. With proper burners—preferably with a bye-pass flame—and chimneys that do not give way, the life of a hood is now more than 700 hours; but it is better to renew the hood, even though unbroken, at the end of 700 hours, for the lighting power has now fallen too much. The other lamps are not in a position to compete with this; and even if the use of the rare earths is not patentable, we still have to do with the fact that

the Welsbach people have secured a practical monopoly of the rare earths, particularly of thorium and lanthanium, for many years to come. The rival patentees thus have to fall back on magnesia, alumina, chromium oxide, zirconia, etc.; and good effects can be attained with these, but not without an increased consumption of gas. And this greater consumption of gas is so considerable that the benefit of a cheaper hood is quite overshadowed by the difference in the gas bill; and the annual charge on the expensive Bunsen burner is vanishingly small in the comparison.

As to the attempt to make hoods which, within the 700 hours, are less fragile, there are two plans—first, to leave on combustion some deposit which shall have the elasticity of a glass fiber network (a result only incompletely attained); or, second, to squirt a paste into the form of threads, which are then fashioned into the desired basketwork form. This last method gives hoods which are much stronger than Welsbach's; but even if the rare earths are so worked up, there is always less proportional surface exposed, and more heat accordingly wasted, than in the Welsbach hoods; so that more gas has to be used to produce a given amount of light, and the cost of running the lamp is some 50 per cent. greater. The Welsbach lamp ought, on the other hand, to be rendered less sensitive to vibrations, so as, at least, to stand the vibration of street traffic; and a good deal has already been done in this direction, by effecting the combustion by compressed gas (52 inches of water); so that Welsbach hoods made in this way can be safely touched and can survive pretty severe shakings.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Pacific Lighting Company, of San Francisco, Cal., has declared its regular monthly dividend of 30 cents per share, payable on demand.

AT the annual meeting of the Carbondale (Pa.) Gas Company the following officers were chosen: Directors, George L. Dixon, C. R. Manville, S. A. McMullen, J. B. Van Bergen and F. E. Burr; President, C. R. Manville; Vice-President, J. B. Van Bergen; Secretary and Treasurer, John F. Wheeler.

A CORRESPONDENT forwards the following: "The 48th annual meeting of the Providence (R. I.) Gas Company was held on the 4th inst., the President, Mr. Royal C. Taft, presiding. The minutes of the last meeting having been read and approved, the amendment to the charter, changing the time of the annual meeting from the first Monday of September to the first Monday of March, was accepted. A Board of Directors was elected, as follows: William Goddard, Alpheus B. Slater, Royal C. Taft, Edward Pearce, Jesse Metcalf, George W. R. Matteson, Lucien Sharpe, Newton D. Arnold and J. Edward Studley. The Directors subsequently organized by electing as President Mr. Royal C. Taft; Vice-President, Mr. William Goddard; Secretary and Treasurer, Mr. A. B. Slater. The report of the Board of Directors was read and accepted, and from it the following statistics are taken: There was no material change in the system, or extraordinary expenses. The quantity of gas consumed during the year amounted to 487,279,400 cubic feet, a decrease from the previous year of 2,066,200 cubic feet. This represents a loss in consumption of ¼ of 1 per cent., but it is certain that such shrinkage is only temporary, as the present business indicates a gain well in advance of the normal for ordinary business years. Of the gas distributed 51 per cent. was coal gas and 49 per cent. was water gas. The net receipts for residual products—coke, coal tar and ammoniacal liquor—footed up $44,601.77. During the year 22,214 tons of caking coal were used in the manufacture of coal gas; and in the water gas department 3,932 tons of anthracite coal, 129,635 bushels of coke and 1,342,607 gallons of naphtha were used. Main pipes to the extent of 52,769 feet were laid, increasing the total length of mains to 210 miles. Services to the number of 731 were put in. The number of gas stoves in use at the end of the year was 7,932, a gain of 854 over 1893. During the year the dock at the South Station was dredged at a cost of $3,718. The Company the past year paid to the city, under the street franchise contract, $16,116.50, and since August 8th, 1892, the amount paid to the same account has been $38,699.94. The announcement of the death of the late President, Mr. Amos C. Barstow, together with the action of the Directors at the annual meeting in September, was also embodied in the report, which was accepted."

AT the annual meeting of the Charleston (S. C.) Gas Company, the Directors elected were: Messrs. Geo. W. Williams, John S. Riggs, Geo. L. Buist, Henry Young, M. Israel, H. H. LeLeon, John S. Simonds and Wm. Hartz.

THE Senate Committee on Miscellaneous Corporations has reported favorably the measure known as the Persons bill, which proposes to abolish the office of State Inspector of Gas Meters, now held by Anthony Clinchy, of this city, at a salary of $5,000 per annum; also, the offices of the three deputy inspectors, who are paid $1,500 each per annum.

ON Wednesday of this week, the State Board of Gas and Electric Light Commissioners will give a hearing on the petition of certain residents of Brockton, Mass., who ask for a reduction in the price and an improvement in the quality of gas supplied in that city.

MRS. Maria L. Ruggles, of Worcester, Mass., who is largely interested in the gas works at Gardner, Mass., has instituted a suit for damages in the sum of $3,000 against Frank L. Allen, a sewer contractor. Plaintiff alleges that defendant, while constructing a system of sewers in Gardner, failed to properly shore the pipes of the gas company, such neglect causing many breaks in the company's distributing system, and the loss to it of many thousand cubic feet of gas.

MR. ADAM WEBER, of the Manhattan Fire Brick and Enameled Clay Retort Works, informs us that the following contracts are now on his order books: Stack of 5 benches of 9's for the United Gas Improvement Company's plant at Atlanta, Ga.; 10 benches of 9's for the Havana (Cuba) Company; 10 benches of 9's for the Brooklyn (N.Y.) Gas Light Company; 20 benches of 6's, Potrero Station, San Francisco Gas Company; 10 benches of 6's, Buffalo (N. Y.) Citizens Gas Company; 4 benches of 6's, Buffalo (N. Y.) Mutual Gas Company—renewals; 936 retorts for the Consolidated Gas Company, New York city. All this work will be made up at Mr. Weber's new and thoroughly equipped manufactories at Weber, Middlesex county, N. J.

THE offices and warerooms of the Bartlett Lamp Manufacturing Company have been removed from 40 and 42 College Place to 39 and 41 West Broadway, this city. This change was necessitated by the carrying out of the plan of the widening of College Place, and when the changes are completed the Bartlett Company's new quarters will be most conveniently located.

THE town of Wakefield, Mass., will expend $4,000 for the extension of its recently acquired gas plant.

THE Council of Norwich, Conn., has adopted the following: "*Resolved*, That it is the opinion of this Court of Common Council that it is desirable that the charter of the city should be so amended that the city will have power to establish gas and electric light plants. It is our opinion that such plants are desirable, both for the purpose of furnishing gas and electric lights for municipal use and for the use of the inhabitants of the city."

THE proprietors of the Brookline (Mass.) Gas Light Company have given notice that they will cause to be sold, on Wednesday next, 2,226 shares of treasury stock at public auction in Boston. This stock is a part of that which the Company may issue under the decision of the Board of Gas and Electric Light Commissioners.

GEORGE W. BAKER, a trusted employee of the Portland (Me.) Gas Light Company, is missing, under circumstances which point to incorrect financial dealings on his part.

MR. KEEFER, of the Pennsylvania Legislature, is responsible for the introduction of a bill which authorizes any "borough that may become the owner of an electric light plant within its corporate limits to extend it and manufacture electricity for use of persons, partnerships and corporations adjacent to such limits."

THE new office buildings of the Indianapolis (Ind.) Gas Company, to replace the quarters destroyed by fire some time ago, have been planned and work thereon will be commenced as soon as the frost is out of the ground. The structure is to cost $250,000.

THE attempt to annul the charter of the Queen City Gas Company, of Buffalo, N. Y., has failed. More's the pity.

THE proprietors of the Brookline (Mass.) Gas Light Company have ordered that the price of gas be reduced to $1 per 1,000 cubic feet in the Brookline and Brighton districts of Boston, the reduction to date from April 1st. The reduction is a voluntary one, for the Board of Gas and Electric Light Commissioners decided, after hearing an appeal of the consumers of the district for a reduction, that the Company might charge $1.40 per 1,000.

WE regret to report that the lower branch of the Massachusetts Legislature has rejected the bill to increase the salaries of the members of the Board of Gas and Electric Light Commissioners in the sum of $500 per annum each.

THE new power plant for the Nassau Electric Railroad Company, at South Brooklyn, N. Y., is completed. This building was designed and

built by the Berlin Iron Bridge Company, of East Berlin, Conn., and it houses an engine and dynamo room 58 feet wide and 150 feet long, equipped with a 13-ton crane, having a travel the full length of the building. This portion of the plant is covered with the Berlin Company's patent anti-condensation corrugated iron roof lining. The boiler room, which is 47 feet in width, is of the same length as the engine and dynamo room, and is so arranged that 2,000 tons of coal can be stored in the pockets.

In reply to "A. C.," we may say that the works of the Pintsch Compressing Company, at Mott Haven, N.Y., have been operated for some months by the New York Central and Hudson River Railroad Company.

The properties of the Cleveland (Ohio) Gas Fixture Manufacturing Company have been purchased by the proprietors of the Cleveland Gas and Electric Fixture Company, a corporrtion formed to take over the possessions of the first-named concern, which has been legally declared defunct.

The Backus Gas Heater and Fixture Company, of St. Louis, has been incorporated by Messsrs. Emerson McMillin, James Campbell, Alex. Ross, Isaac H. Lionberger and Luther H. Conn. It is capitalized in $100,000.

A fire is reported from La Crosse, Wis., which destroyed the storage sheds of the local Gas Company. The damage is put at $2,500.

The following explains to a nicety the position of the Montreal (Can.) Gas Company in respect to the gas supply of that city: "G. Marsolais, Esq., Chairman of the Light Committee, Montreal—Dear Sir: In reply to your letters of the 6th and 20th February, I beg leave to inform you that this Company cannot enter into a contract to furnish the citizens with gas at the price contracted for by John Coates & Co., as it is impossible for it to manufacture and distribute gas at those prices, let alone pay dividends to its shareholders. This Company is prepared to enter into a contract for 10 years at the present prices charged, viz.; $1.30 per 1,000 cubic feet, net, for lighting, and $1 per 1,000 cubic feet, net, for heating and cooking. I may say that these prices compare most favorably with the prices charged in the large cities of the United States, where the output of gas is from three to ten times as much as in Montreal, and where climatic conditions are more favorable and the material from which the gas is manufactured can be bought for about half the price we have to pay for it. If the City Council are prepared to enter into a contract for a longer term of years, this Company will submit a more favorable offer than the above. *First*—On the basis of taking the city into partnership, by giving it a percentage of the earnings of the Company. *Second*—Or they will enter into a partnership with the consumers, by which they will agree to reduce the price of gas from time to time, after providing for a regular fixed dividend on the capital stock of the Company. I would beg leave to draw your attention to the fact that this Company has invested over three millions of dollars in its works and mains in the city of Montreal, which fact, I think, should be taken into consideration by the Council when they are considering this question.—H. S. Holt, Pres."

The Automatic Gas Machine Company, of Erie, Pa., has been incorporated with a capital of $10,000.

Mr. Novak, representing a Chicago district in the lower branch of the Illinois Legislature, has introduced a bill looking to the establishing of a minimum gas rate for the State, on the following basis: In cities of 100,000 inhabitants and over, 75 cents per 1000; in cities of less than 100,000 and more than 50,000, $1 per 1,000; in cities of less than 50,000 and more than 20,000, $1.25; in cities of less than 20,000, $1.50 per 1,000. The bill also prescribes the illuminating value and purity of the product that shall be distributed, and arranges for the testing of the gas by the city authorities.

Mr. Isaac Battin Treasurer and Superintendent of the Omaha Gas Manufacturing Company reports that notwithstanding the general depression in business, which is all the more intensified in Nebraska by the failure of last year's wheat crops in that State, the Company's output for the year more than held its own when compared with the output of a year ago. Fuel gas and the Welsbach burner account for this successful report.

Mr. William S. Waterbury, for many years Chief Clerk in the office of Secretary of State of New York, and who engaged in the gas business at Ballston Spa, when the Republicans came into power, has been appointed Chief Clerk in the office of the United States Public Printer.

The proprietors of the New London (Conn.) Gas Light Company have ordered a reduction in the selling rate of 50 cents per 1,000 cubic feet—from $2.50 to $2.

"Observer" writes us that it is more than probable that the selling rate at Bridgeport, Conn., will shortly be reduced to $1.50 per 1,000 cubic feet, a concession of 40 cents.

The San Antonio (Tex.) Gas Company is supplying the city with arc lamps (2,000-candle power) at the rate of 40 cents per light per night on a moon table. The charge made for each 16-candle power incandescent electric lamp is three-fourths of a cent per ampere hour.

Mr. W. J. Max, Superintendent of the Middletown (N. Y.) Gas and Electric Light Company, says that the Welsbach lamp has regained the Company many of its old and largest consumers, and the output for the past twelvemonth shows an increase of 18 per cent. over the previous year. The Company has placed 825 Welsbachs, which replaced 475 incandescent electric lamps and 75 oil lamps. The consumers of oil who have gone over to gas concede that the Welsbach burner gives them a better light at a less cost than that formerly obtained from oil, cost of the latter and chimney renewals being given due consideration.

The proprietors of the Kansas City Gas Light and Coke Company have filed a petition in the United States Circuit Court for the Western District of Missouri for a permanent injunction restraining the city from enforcing the ordinance fixing the gas rate at $1 per 1,000 cubic feet.

The Victoria (B. C.) Electric Light Company's works were badly damaged, towards the close of February, by a fire, which occasioned a loss not less than $8,000.

Messrs. Jas. H. Matheny, P. W. Harts and Edwin A. Wilson have been granted a license for the Provident Gas Company, the proposed field of operation being Springfield, Ills. It is capitalized in $100,000, and the whole thing has a very fishy look, likewise a fishy smell.

The Milwaukee, Wis., Company, according to the local papers, has a plan "for aiding citizens to secure gas ranges and utilize fuel gas at greatly reduced prices for equipping their homes with the article. A great drawback to the universal introduction of gas ranges and the use of fuel gas has heretofore been the cost of equipping houses for the service. In the first place gas ranges range in price from $25 to $30 each, to put in pipes entailed an additional expense of $5, and to make the gas connection for this purpose represented another $5 to each customer. The Company has decided to invest about $20,000 between April 1 and August 1, next, in aiding people of modest means to put in gas ranges, and at the end of that time hopes to be able to have fully 2,000 fuel gas consumers in the city instead of but 700, as at present. The scheme is in the shape of a proposition to hardware dealers to sell gas ranges to citizens at 50 per cent. of their actual cost, and then, when the Company has an accurate account of all such deals, it will make good to all such dealers the difference in the price at which they sold and the actual retail price, together with a reasonable profit. Connections will be made free by the Company. Some of the dealers, however, object to the proposition, inasmuch as they feel that the plan would greatly interfere with their regular trade in other kinds of ranges."

A Firedamp Indicator.

A committee appointed by the Paris Académie des Sciences has recently reported favorably upon a firedamp indicator due to M. E. Hardy. The apparatus depends upon the fact that the pitch of a pipe will vary with the density of the gas inclosed in it. Thus if the gas inclosed in one pipe is pure air, whilst that of another exactly similar pipe is slightly contaminated with firedamp, the natural notes of the two will differ in pitch, and "beats" will be established between the two. The number of these beats in a given time is a measure of the difference in density of the pure and impure air, and hence of the firedamp present in the latter. The experiments of the commission were made in an airtight case divided into two compartments, one of the pipes being placed in each. Both of these pipes are adjusted to give exactly the same note when supplied with the same air. In using the apparatus one compartment was filled with pure air, whilst that in the other was diluted by various proportions of lighting gas. Sound tubes lead from each pipe to the ears of the observer. On both pipes being sounded together it was found that when the amount of lighting gas present was 2 per cent. there were 30 "beats" in 10 seconds; when the amount was 1 per cent. the number of beats in 10 seconds was 15; and when ½ per cent. it was 8 to 9. Subsequent improvements by the inventor have allowed of as little as ¼ to ½ per cent. of gas to be detected. It is proposed that the apparatus should be permanently fixed in mine galleries and connected by telephone to the surface. The commissioners also suggest that the "beats," by means of an electric relay, should work an automatic recorder, which would show at any time the degree of purity of the air in the workings, but the details of this have not yet been worked out.

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, MARCH 18, 1895.

The Market for Gas Securities.

The city gas share market was steady to strong during the week, especially in respect of Consolidated, which opened to day (Friday) at 132⅞ bid, offered at 133. The sales on the Exchange in this specialty yesterday footed up 2,445 shares, the opening having been made at 131½, and the closing bid price was 132¾, with sales between opening and closing at 133. There is every indication of a sharp upward movement in the stock, and we have no doubt that the highest prices ever made in it will be recorded this year.

The Legislature shows no particular disposition to interfere with gas rates, and the Governor, fair-minded and acute capitalist that he is, knows full well the difference between unjust and tolerable legislation as affecting corporate interests. To further show the just trend of legislation regarding the gas industry of the State, we make mention of a bill introduced in the Assembly yesterday by Mr. Abell, of Kings, which proposes a Gas Commission based somewhat on the lines of the Massachusetts law; and we are sure the measure is to receive fair consideration.

Other city shares are in good demand. We note a sale at auction of 100 shares Standard common, at 39⅛ to 38¼.

Brooklyn shares are nominally strong, with a decided increasing tendency in quotations for old Brooklyn.

Chicago gas is about as before, and Bay State is very uneven and weak at 14 to 14½. The Company's affairs seem to be hopelessly tangled. Baltimore is in demand, at 62 to 63.

Milwaukee stock is looking up considerably, being bid for at 44½, holders asking two points more. The 5's are also in fair demand, at 82 bid, which is really on a 6 per cent. basis. Laclede common holds its own fairly well, and Washington (D. C.) is notably higher, sales having been made at 250.

Tests of Non-Conducting Pipe Coverings.

A series of tests have been made at the St. Louis Water Works by John A. Laird, to select the most suitable covering for pipes, boiler shells, etc., in the new pumping station at the Chain of Rocks. The report appears in the "Proceedings" of the Association of Engineering Societies. There were purchased asbestos sponge molded sectional covering, asbestos fire felt sectional covering and magnesia sectional covering, all for 1-inch pipe. Also asbestos sponge cement felting, asbestos cement felting, plastic magnesia and fossil meal. Tests were also made on plaster of paris and sawdust, molded into covering for 1-inch pipe.

The different coverings were subjected to chemical examination by Mr. Wixford, chemist of the water works, with the following approximate results:

Asbestos Sponge, Molded.

Plaster of paris	95.8
Fibrous asbestos	4.2

Asbestos Fire Felt.

Asbestos	82.0
Carbonaceous matter not determined	18.0

Magnesia (Sectional).

Magnesia	92.2
Fibrous asbestos	7.8

Magnesia (Plastic).

Magnesium carbonate	93.0
Fibrous asbestos	7.0

Asbestos Cement Felting.

(Probably) powdered limestone	64.5
Plaster of paris	3.5
Asbestos	32.0

Asbestos Sponge Cement Felting.

(Probably) powdered limestone	59.0
Plaster of paris	10.0
Asbestos	31.0

Fossil Meal.

Insoluble silicate	80.0
Carbonaceous matter, hair, paper, sawdust, etc	12.0
Soluble mineral matter	8.0

On all condensation tests the gauge pressure was held at 25 pounds. The water was drawn off every 15 minutes and was measured in cubic centimeters. Each test was continued for four hours. The mean results are tabulated below:

Condensation Tests.

Name of Covering.	Ccm. Condensed per Hour.
Magnesia (plastic)	334.0
Magnesia (sectional)	335.3
Asbestos fire felt	367.5
Asbestos sponge, molded	371.3
Fossil meal	376.2
Plaster of paris and sawdust	438.0
Asbestos fire felt cement	563.7
Asbestos sponge cement	604.0
Bare pipe	1,085.0

On the question of durability, Mr. Laird states that the magnesia sectional covering which has been on pipe at Bissell's Point for four years shows no signs of deterioration; also that the asbestos sponge molded covering which has been on pipes at Harlem Creek for less than two years is becoming soft, and the plaster of paris seems to be reduced back to the original powder, with nothing but the fibrous asbestos to hold it together. Another question is that of steam pressure. The experiments were made at the High Service Station, No. 2, and it was found convenient to have all tests made at 25 pounds gauge pressure. As the working pressure at Chain of Rocks will be at least 125 pounds, the relative efficiency of insulation will be slightly changed, but in Mr. Laird's opinion, not enough to change the conclusions here arrived at.

Injuries to Workingmen from Defective Machinery.

The *Woodworker* says it is settled beyond controversy that it is the duty of an employer to furnish a suitable and safe place for his employee to work, and suitable and safe appliances and machinery for him to work with, yet it is in the power of the employee to dispense with this obligation. When he assents to occupy the place prepared for him, and incur the dangers to which he will be exposed, having sufficient intelligence and knowledge to comprehend them, it is not a question whether such place might, with reasonable care and by reasonable expense, have been made safe. His assent has dispensed with the performance on the part of the employer to make it so. Obvious imperfections in machinery, existing at the time of the employment, cannot be made the basis of liability in favor of the employee.

The employer, however, is not exempt unless the employee knows, or ought to know, the danger to which he is exposed by working with or near defective machinery or appliances. In the absence of such knowledge the employee is not chargeable with negligence because he does not abandon his employment, and he cannot be said to have voluntarily exposed himself to such danger. It must appear that he not only knew, or had the means of knowledge, of the unsafeness of the place, appliances or machinery, but also that he knew, or ought to have known, of the danger to which he was himself personally exposed. The true test is whether he ought not to have comprehended it; that is, whether an ordinarily prudent person of his age and experience, under like circumstances, would have appreciated the danger and risk. Of course, wherever the employee's means of information are equal to or greater than those of his employer, the latter will not be liable in case of injury from the defect. But he must, when notified of defects, see that they are repaired, and cannot excuse himself for failure to have repairs made by showing that it was the duty of some employee to make them.

It is now almost equally well settled that if an employee who has knowledge of defects in the instrumentalities furnished for his use gives notice thereof to his employer, directly or indirectly through his foreman, superintendent or other agent of the employer, who thereupon promises that they shall be remedied, the employee may recover for any injury caused by such defective appliances or machinery, at least where the master, directly or indirectly, requested him to continue in the work, and the injury occurred within the time in which the defects were promised to be remedied, and where the instrumentality, although defective, was not so imminently and immediately dangerous that a man of ordinary prudence would have refused longer to use it; under such circumstances his subsequent use of the defective instrumentality would not necessarily, or as a

matter of law, make the employee guilty of contributory negligence, but it would be a question for the jury, whether, in continuing its use after he knew of the defect, he was in the exercise of ordinary care.

Many of the cases go even farther than this, but this is as far as it is necessary to go in a general consideration of the subject. Courts differ as to the grounds on which it should be placed. Some place it on the ground of policy and justice, upon a consideration of the unequal situation of employer and employee, or master and servant, to use the legal classification; others upon the ground that in such cases the facts rebut the presumption of a waiver on the part of the employee; others upon the ground of a contract on the part of the employer, implied from the fact that if the servant continues in the service in the meantime, and until the defect is remedied, the employer and not the employee will assume the risk. It is not essential to attempt to determine which of these is the best or most logical reason for the rule, except to say that the last seems very forcible, especially where there is a request to the employee to continue in the service. It is sufficient that the rule has generally recommended itself to the judicial mind as founded in sound policy and common justice. If the emergencies of an employer's business require him temporarily to use defective machinery, we fail to see what right he has in law or natural justice to insist that it shall be done at the risk of the employee and not his own, when, notwithstanding the objection of the former to the condition of the machinery, he has requested or induced him to continue its use under a promise thereafter to repair it.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

March 18.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$25,450,000	100	183¾	138
Central	500,000	50	..	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	181	183
Bonds, 6's	1,000,000	..	107	..
" 5's	.....	..	111	..
" 1st Con. 5's	2,300,000	..	..	..
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	154	..
" Bonds	1,500,000	..	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	..	..
" Bonds	150,000	..	03	98
New York and East River	5,000,000	100	22	24
Preferred	2,000,000	..	40	44
Bonds	3,500,000	100	83¾	84¾
Richmond Co., S. I.	248,650	50	50	..
" Bonds	100,000	..	..	..
Standard	5,000,000	100	58½	..
Preferred	5,000,000	100	80½	..
Bonds, 1st Mortgage, 5's	1,500,000	..	102½	105
Yonkers	.....	50	112	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	125	..
Citizens	1,200,000	20	65	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	100	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	175	..
" Bonds	300,000	..	103	..
Peoples	1,000,000	10	85	..
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	170	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	200	..
" Ctfs.	700,000	1,000	99	100
Williamsburgh	1,000,000	50	190	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	15	14	14¼
" Income Bonds	2,000,000	1,000	23	25
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	73	75
2d " " "	3,000,000	1,000	46	47
Buffalo Mutual	750,000	100	120	..
" Bonds	200,000	1,000	95	100
Chicago Gas Co.	25,000,000	1,000	71⅝	71¼
Chicago Gas Lt. & Coke Co.				
Guaranteed Gold Bonds.	7,650,000	1,000	93	93½
Columbus	1,069,000	..	..	..
1st Mortgage	1,085,000	..	..	..
Consumers, Jersey City	2,000,000	100	72	77
" Bonds	600,000	1,000	95	98½
Cincinnati G. & C. Co.	7,000,000	100	..	203¾
Consumers, Toronto	1,600,000	50	184½	187
Central, San Francisco	.....	..	90	100
Capital, Sacramento	.....	..	..	50
Consolidated, Baltimore	11,000,000	100	62½	63¾
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	18	..
" Con. Bonds	4,312,000	..	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	74	75
" Bonds	2,000,000	..	81	82
Hartford, Bonds	750,000	25	120	128
Indianapolis	2,000,000	..	137	..
" Bonds, 6's	2,650,000	..	103	..
Jersey City	750,000	20	190	200
Lafayette Gas Co., Ind.	.....	..	87	..
Bonds	.....	..	90	..
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	25½	26
Preferred	2,500,000	100	82	84
Bonds	9,034,400	1,000	..	..
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	208
New Haven	.....	25	200	..
Oakland, Cal.	.....	..	42½	43
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	..	167	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	80	85
Preferred	2,150,000	50	81	..
Bonds, 6's	.....	..	..	..
Consolidated 5's	.....	..	..	..
Syracuse, N. Y.	500,000	25	..	..
San Francisco, Cal.	10,000,000	100	73⅝	73¾
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	.....	100	44½	46¼
Bonds	.....	..	82	84
Wilmington, Del.	500,000	50	188	190

Advertisers' Index.

GAS ENGINEERS.

	Page
Jos. R. Thomas, New York City	396
Wm. Henry White, New York City	396
Fred. Bredel, Milwaukee, Wis.	391
H. C. Slaney, Brooklyn, N. Y.	395
Geo. R. Rowland, New York City	395
The Western Gas Construction Co., Fort Wayne, Ind.	386
Humphreys & Glasgow, New York City	382
T. G. Lansden, St. Louis, Mo.	395
David Leavitt Hough, New York City	376

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	393
United Gas Improvement Co., Phila., Pa.	385
Burdett Loomis, Hartford, Conn.	394
National Gas and Water Co., Chicago, Ills.	387
Economical Gas Apparatus Construct'n Co., Toronto, Ont	399
The Western Gas Construction Co., Fort Wayne, Ind.	386
A. M. Sutherland, New York City	379

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	396
Continental Iron Works, Brooklyn, N. Y.	394
Deily & Fowler, Phila., Pa.	396
Kerr Murray Mfg. Co., Fort Wayne, Ind.	392
Stacey Mfg. Co., Cincinnati, Ohio	395
Bartlett, Hayward & Co., Baltimore, Md.	393
Davis and Farnum Mfg. Co., Waltham, Mass.	392
R. D. Wood & Co., Phila., Pa.	394
Isbell-Porter Company, New York City	394
Fred. Bredel, Milwaukee, Wis.	391
United Gas Improvement Co., Phila., Pa.	385
Berlin Iron Bridge Co., East Berlin, Conn.	389
National Gas and Water Co., Chicago, Ills.	387
Economical Gas Apparatus Construct'n Co., Toronto, Ont	399
The Western Gas Construction Co., Fort Wayne, Ind.	386
Humphreys & Glasgow, New York City	382
Gas Engineering Co., Pittsburgh, Pa.	379

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City	395
R. D. Wood & Co., Phila., Pa.	394
James R. Floyd & Sons, New York City	396
Continental Iron Works, Brooklyn, N. Y.	394
Gas Engineering Co., Pittsburgh, Pa.	379

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md.	393
Fred. Bredel, Milwaukee, Wis	391
J. H. Gautier & Co., Jersey City, N. J.	391
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	390
Adam Weber, New York City	390

TAR AND CARBONIC ACID EXTRACTOR.

G. Shepard Page's Sons, New York City	395

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	376
G. Shepard Page's Sons, New York City	395
Gas Engineering Co., Pittsburgh, Pa.	379

GAS METERS.

John J. Griffin & Co., Phila., Pa.	390
American Meter Co., New York and Philadelphia	399
The Goodwin Meter Co., Phila., Pa.	398
Helme & McIlhenny, Phila., Pa.	399
D. McDonald & Co., Albany, N. Y.	390
Nathaniel Tufts, Boston, Mass.	398
Maryland Meter and Mfg. Co., Baltimore, Md.	398
Harris Bros. & Co., Phila., Pa.	398
Metric Metal Co., Erie, Pa	397

GAS AND WATER PIPES.

Ohio Pipe Co., Columbus, Ohio	397
M. J. Drummond, New York City	397
R. D. Wood & Co., Phila., Pa.	397
Warren Foundry and Machine Co., New York City	397
Donaldson Iron Co., Emaus, Pa.	397
Addyston Pipe and Steel Co., Cincinnati, O.	396
John Fox, New York City	397

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City	391

GAS COALS.

Penn Gas Coal Co., Phila., Pa.	389
Perkins & Co., New York City	388
Despard Gas Coal Co., Baltimore, Md.	389
Westmoreland Coal Co., Phila., Pa.	389
Shaner Coal Co., Philadelphia, Pa.	376

CANNEL COALS.

Perkins & Co., New York City	388
Log Mountain Coal, Coke and Timber Co., Pineville, Ky.	389

GAS ENRICHERS.

Standard Oil Co., New York City	389
The Sun Oil Co., Pittsburgh, Pa.	389
W. H. Townsend, New York City	389

COKE CRUSHER.

C. M. Keller, Columbus, Ind.	389

CONVEYING MACHINERY.

C. W. Hunt Company, N. Y. City	376

GAS GAUGES.

The Bristol Co., Waterbury, Conn.	391

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City.	387
Wilbraham Baker Blower Co., Phila., Pa.	387
Isbell-Porter Co., New York City	394

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City	394
Continental Iron Works, Brooklyn, N. Y.	394
G. Shepard Page's Sons, New York City	395

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J.	390
B. Kreischer & Sons, New York City	390
Adam Weber, New York City	390
Laclede Firebrick Mfg. Co., St. Louis, Mo.	390
Cyrus Borgner, Phila., Pa	390
James Gardner, Jr., Pittsburgh, Pa.	390
Henry Maurer & Son, New York City	390
Baltimore Retort and Firebrick Co., Baltimore, Md.	390
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	390
Brooklyn Firebrick Works, Brooklyn, N. Y.	390
F. Behrend, New York City	390

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N. Y.	390
F. Behrend, New York City	390

INCANDESCENT GAS LAMPS.

Welsbach Light Co., Gloucester, N. J.	379

BURNERS.

C. A. Gefrorer, Phila., Pa.	394
Moses G. Wilder, Phila., Pa.	376

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn.	376

GAS TUBING.

New York Gas Tubing Co., New York City	376

STREET LAMPS.

J. G. Miner, Morrisania, New York City..... 391
Bartlett Lamp Mfg. Co., New York City..... 391

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 387
Greenpoint Chemical Works, Brooklyn, N. Y..... 387
Henry W. Douglas, Ann Arbor, Mich..... 387
Read, Holliday & Sons, Ltd., New York City..... 380

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind..... 384
Isbell-Porter Company, New York City..... 394
Wilbraham Baker Blower Co., Philadelphia, Pa..... 387
Connelly Iron Sponge and Governor Co., New York City 387

VALVES.

Ludlow Valve Manufacturing Co., Troy, N.Y..... 386
Chapman Valve Manufacturing Co., Boston, Mass..... 386
R. D. Wood & Co., Phila., Pa..... 394
Continental Iron Works, Brooklyn, N. Y..... 394
John Fox, New York City..... 397
The P. H. & F. M. Roots Co., Connersville, Ind..... 384
Isbell-Porter Co., New York City..... 394
The Western Gas Construction Co., Fort Wayne, Ind.... 386

ELECTRICAL APPARATUS.

Wm. Henry White, New York City..... 395

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa..... 400
Th American Gas Engine Co., Phila., Pa..... 377

ENGINES AND BOILERS.

The Hazelton Boiler Co., New York City..... 380

PURIFIER SCREENS.

John Cabot, New York City..... 391

GAS STOVES.

American Meter Co., New York and Philadelphia..... 383
The Goodwin Meter Co., Phila., Pa..... 398
George M. Clark & Co., Chicago, Ills..... 381
Maryland Meter and Manufacturing Co., Baltimore, Md.. 398
The Schneider & Trenkamp Co., Cleveland, O..... 380
William M. Crane & Co., New York City..... 381

CHINA GAS KILNS.

F. A. Wilke, Richmond, Ind..... 396
William M. Crane & Co., New York City..... 381

GAS FLOW COMPUTERS.

Wm. Cox, Stapleton, N. Y..... 398

COIN WRAPPERS.

Alvord & Co., Detroit, Mich..... 388

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass.... 386
New York Marine Paint Co., Poughkeepsie, N.Y..... 380

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y..... 391

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 398
Continental Iron Works, Brooklyn, N. Y..... 394
Delly & Fowler, Philadelphia, Pa..... 396
Davis & Farnum Mfg. Co., Waltham, Mass..... 392
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 392
Stacey Mfg. Co., Cincinnati, Ohio..... 395
R. D. Wood & Co., Philadelphia, Pa..... 394

PATENTS.

H. B. Willson & Co., Washington, D. C..... 380

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The Directors have this day declared a dividend of ten (10) per cent., payable on Mar. 22, 1895, to stockholders of record at the close of business Mar. 15. Checks will be mailed.

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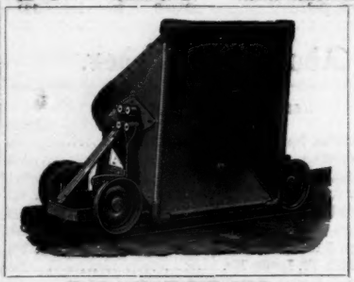

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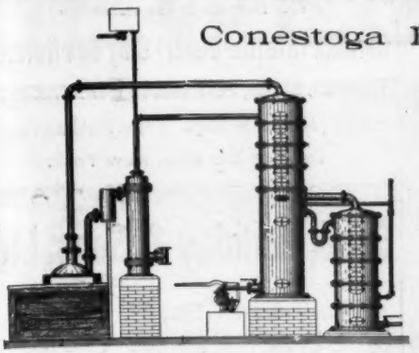

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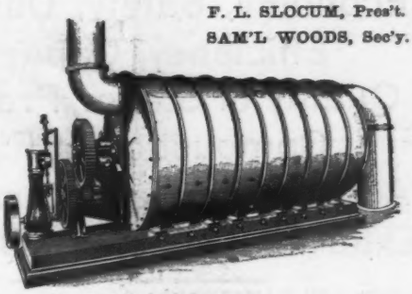

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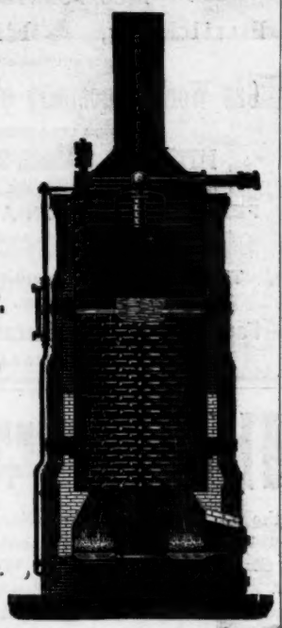

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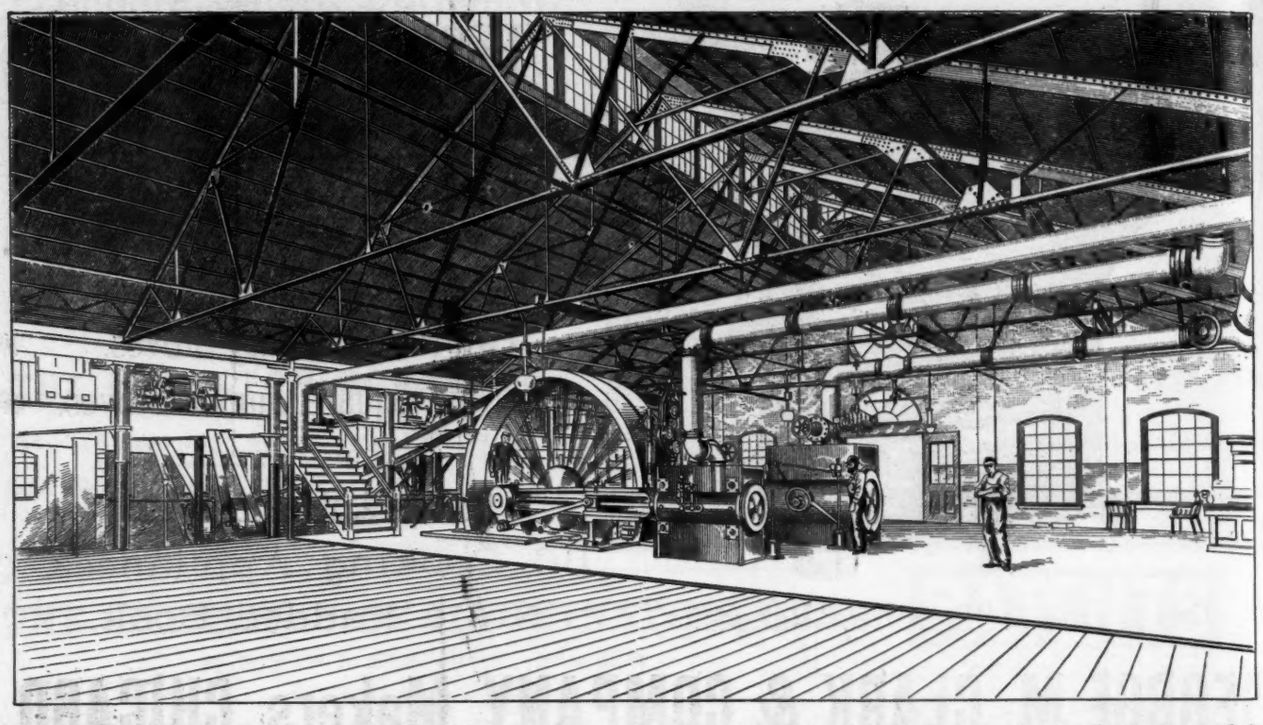

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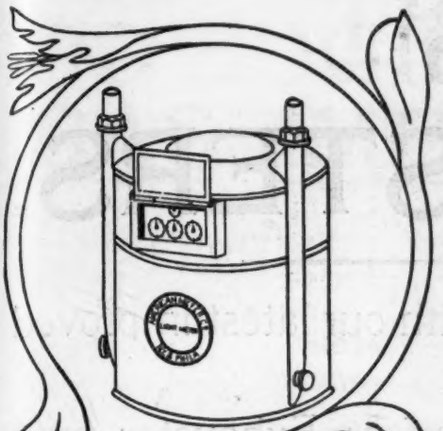

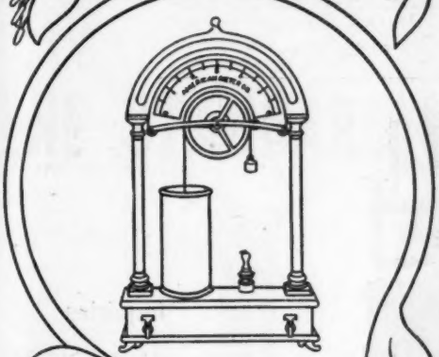

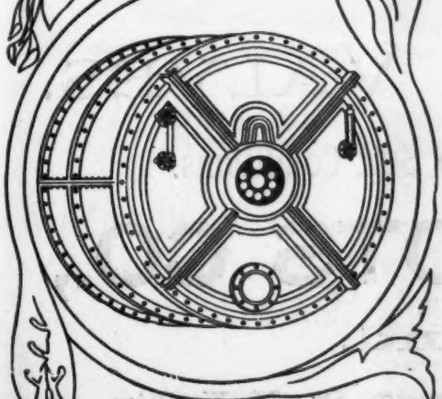

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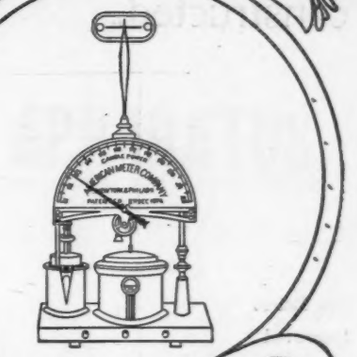
PUBLIC LIGHTING TABLE.

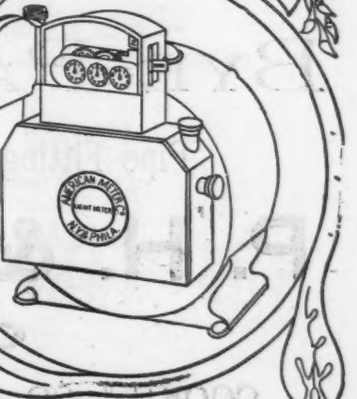
APRIL, 1895.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Mon.	1	12 30 AM	4.40 AM	6.10	4.55
Tue.	2	1.20 FQ	4.40	6.15	4.40
Wed.	3	2.00	4.40	6.15	4.40
Thu.	4	2.40	4.40	6.15	4.40
Fri.	5	3.00	4.40	6.15	4.40
Sat.	6	3.30	4.40	6.15	4.40
Sun.	7	4.00	4.40	6.15	4.40
Mon.	8	No L.	No L.	6.15	4.40
Tue.	9	No L. FM	No L.	6.25	4.30
Wed.	10	No L.	No L.	6.25	4.30
Thu.	11	7.00 PM	10.30 PM	6.25	4.30
Fri.	12	7.00	11.40	6.25	4.30
Sat.	13	7.00	12.40 AM	6.25	4.30
Sun.	14	7.10	1.40	6.25	4.30
Mon.	15	7.10	2.20	6.25	4.30
Tue.	16	7.10 LQ	3.00	6.30	4.20
Wed.	17	7.10	3.30	6.30	4.20
Thu.	18	7.10	4.00	6.30	4.20
Fri.	19	7.10	4.10	6.30	4.20
Sat.	20	7.10	4.10	6.30	4.20
Sun.	21	7.20	4.10	6.30	4.20
Mon.	22	7.20	4.10	6 30	4.20
Tue.	23	7.20	4.10	6.40	4.10
Wed.	24	7.20 NM	4.10	6 40	4.10
Thu.	25	7.20	4.10	6.40	4.10
Fri.	26	7.20	4.10	6.40	4.10
Sat.	27	7.20	4.10	6.40	4.10
Sun.	28	7.20	4.00	6.40	4.10
Mon.	29	11.10	4.00	6.40	4.10
Tue.	30	12.00	4.00	6.45	4.00

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146 30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45





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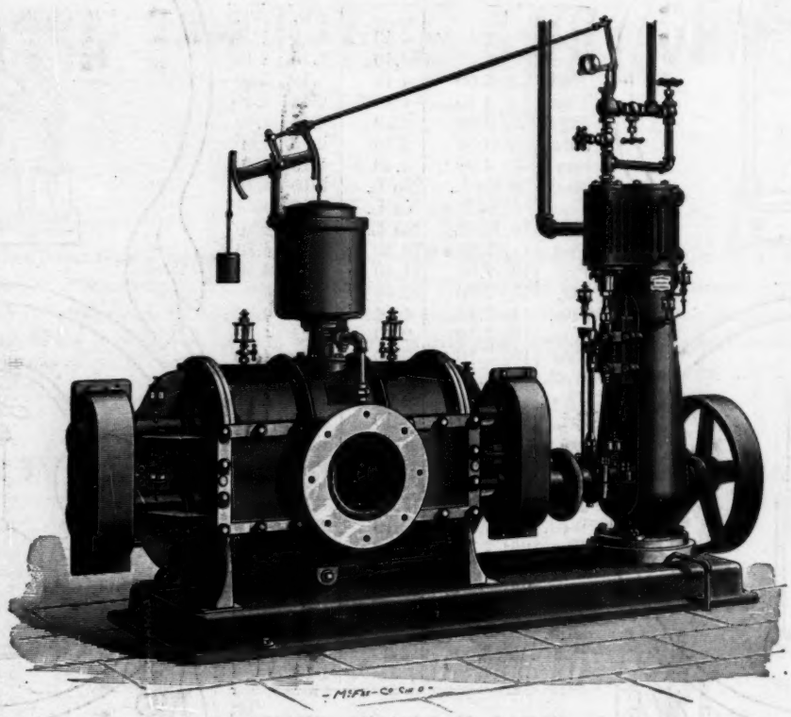

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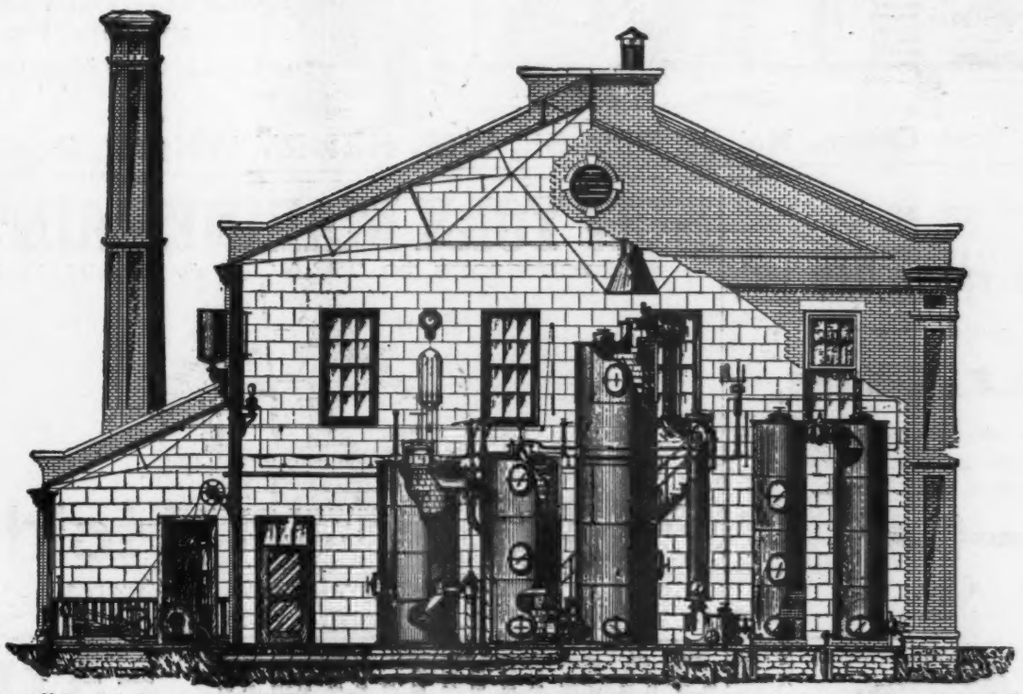

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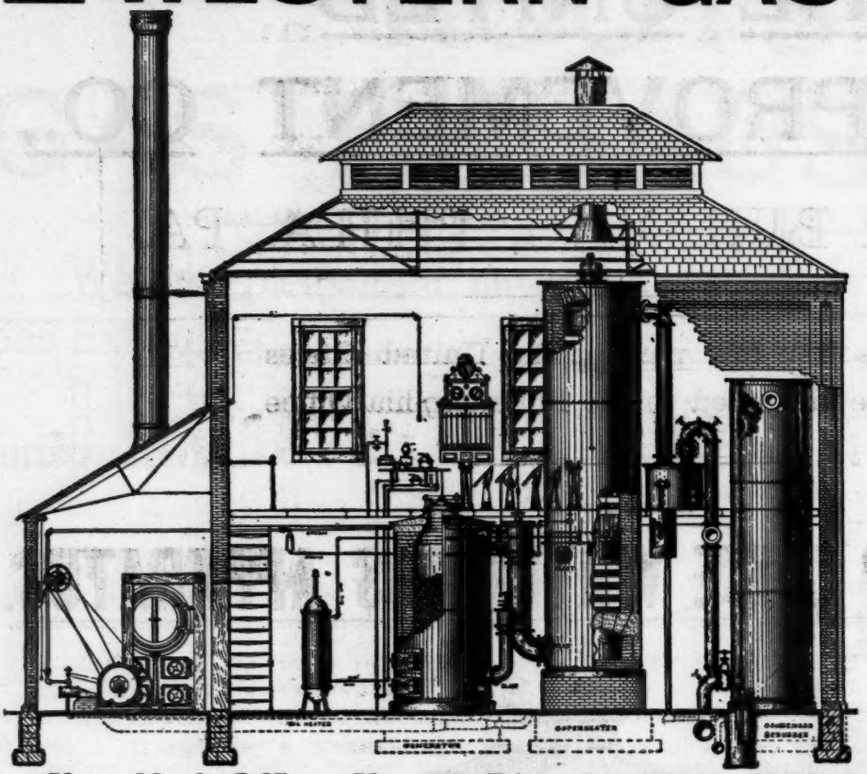

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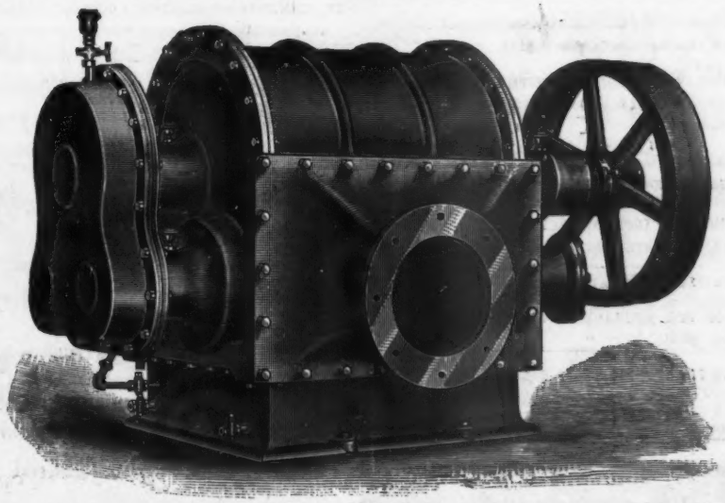

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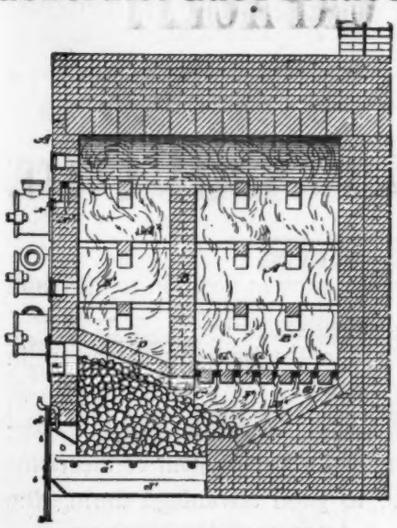

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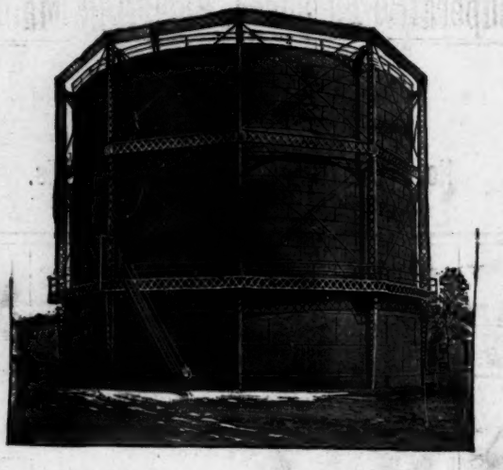

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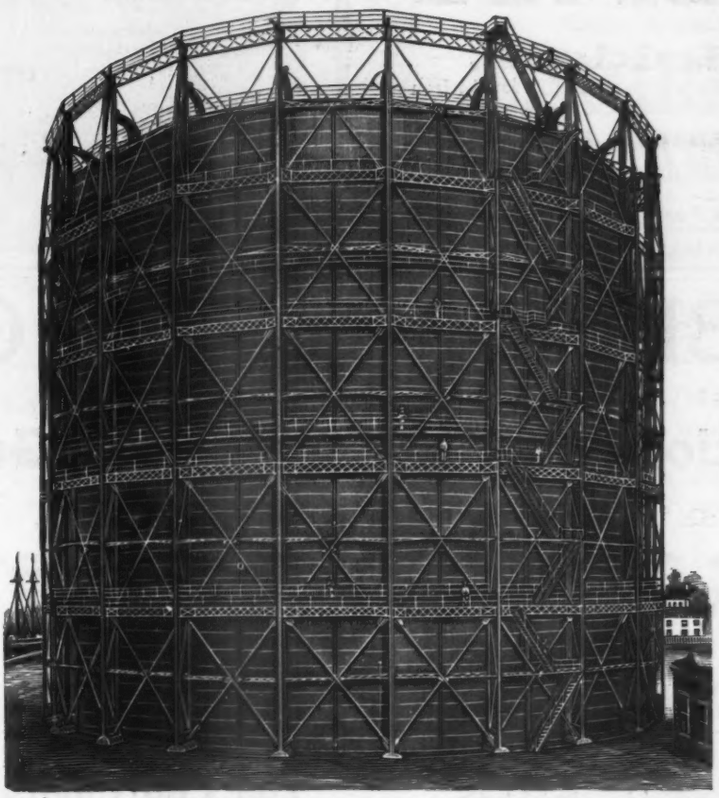

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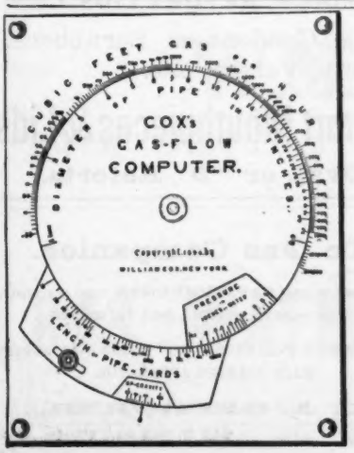

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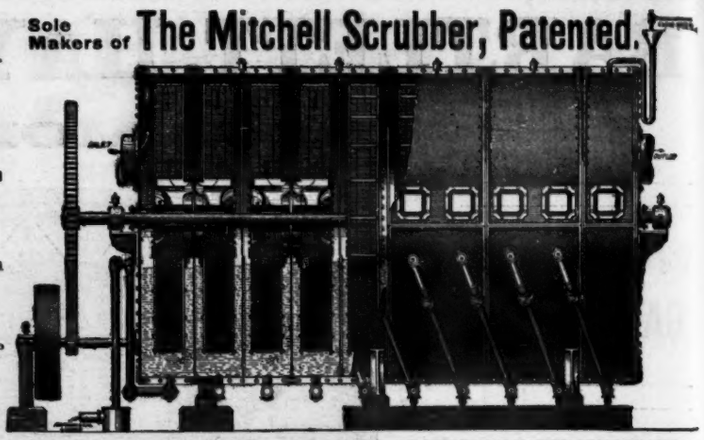

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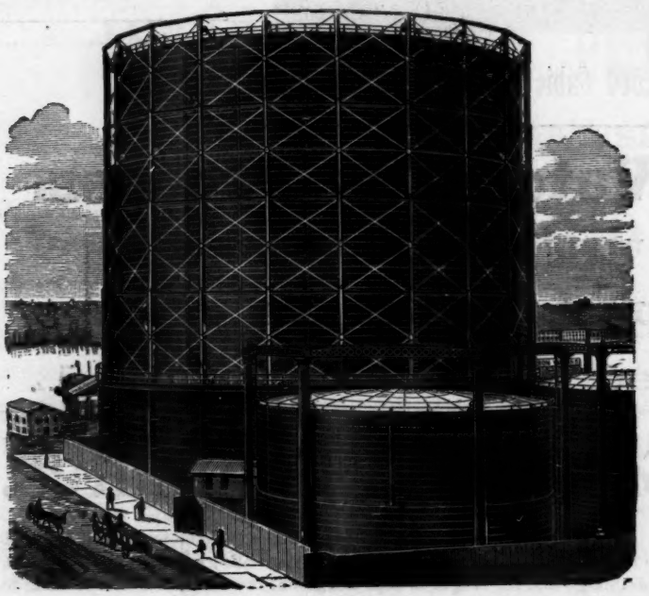

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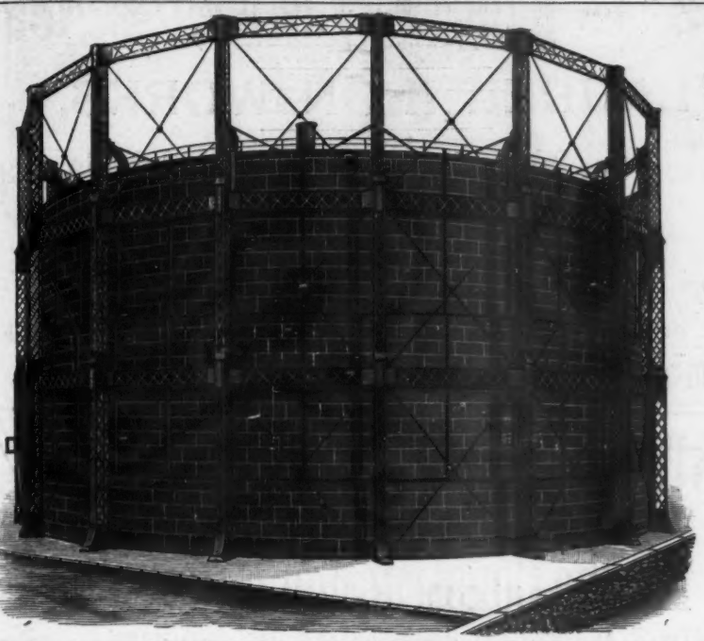

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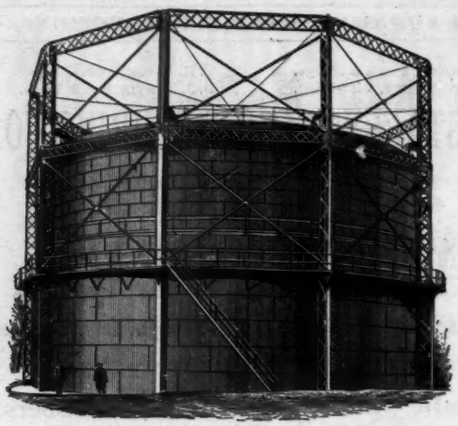

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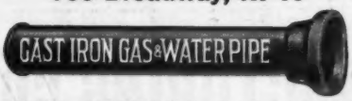

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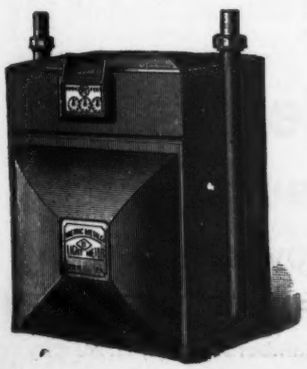

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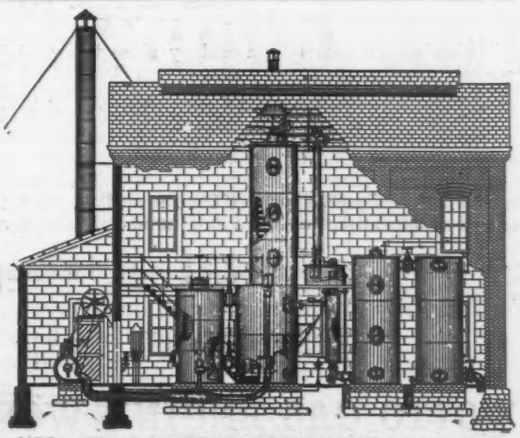

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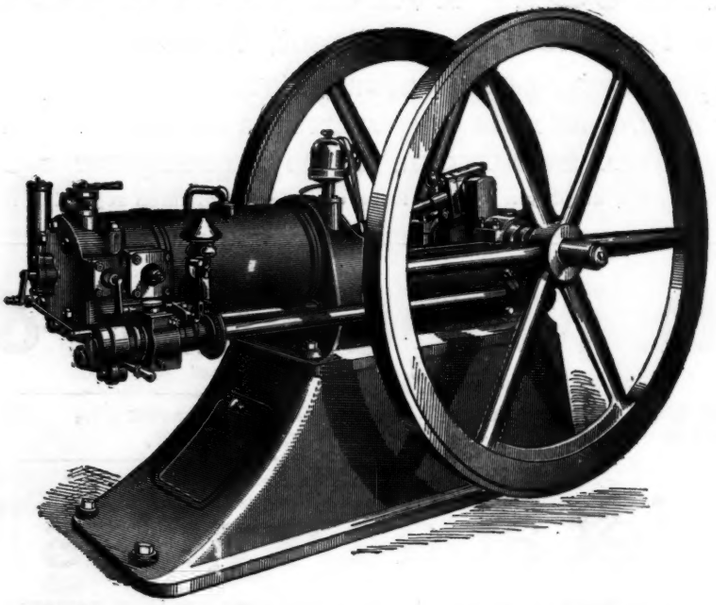

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